FORTY-EIGHTH ANNUAL REPORT

OF THE

# Agricultural Experiment Station

OF THE

UNIVERSITY OF KENTUCKY

▼

~~PART II~~

Bulletins 356-361

IMPERIAL MYCOLOGICAL INSTITUTE
21 APR. 1938

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LEXINGTON

1935

# Agricultural Experiment Station

*of the*

## UNIVERSITY OF KENTUCKY

## FORTY-EIGHTH ANNUAL REPORT

*For the Year* 1935

IMPERIAL MYCOLOGICAL
21 APR. 1938
INSTITUTE

Part I

Report of the Director

# UNIVERSITY OF KENTUCKY

## LEXINGTON, KENTUCKY

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## LETTER OF TRANSMITTAL

*To His Excellency, Hon. A. B. Chandler, Governor of Kentucky:*

Sir: In accordance with an act of Congress, approved March 2, 1887, entitled, "An Act to establish Agricultural Experiment Stations, in connection with the Agricultural Colleges established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," and of the act of the Legislature of the State of Kentucky, approved February 20, 1888, entitled, "An Act to accept the provisions of an act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with Agricultural Colleges established by the several states and territories under an act of Congress approved July 2, 1862," I herewith submit the Forty-eighth Annual Report of the Kentucky Agricultural Experiment Station.

Very respectfully,

THOMAS P. COOPER, *Director*

January 1, 1936.

# ANNUAL REPORT

*of the*

# DIRECTOR OF THE KENTUCKY AGRICULTURAL EXPERIMENT STATION

*For the Year* 1935

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Constantly, during the year, the personnel and physical resources of the Experiment Station were strained by increasing obligations and over-taxed to meet opportunities offered the state. Frequently, personnel was reassigned to direct and develop projects of an emergency nature. Cooperation with the National Government in the conduct of the various adjustment programs increased the work of the Experiment Station, especially in the fields of agronomy and soils, farm economics, marketing and rural finance.

A cooperative project with the United States Department of Agriculture was organized which, for approximately five months, engaged every member of the staffs of the departments of farm economics and of markets and rural finance. The project was a study of adjustments in farming by regions and type-of-farming areas, from the standpoint of agricultural adjustment, planning and soil conservation. It was carried on not only in cooperation with the United States Department of Agriculture, but as a joint project with every other state in this region. It was proposed to differentiate the agriculture of the state into type-of-farming areas or sub-areas, to assemble, coordinate and interpret existing data, to determine the nature and extent of desirable adjustments in farming from the standpoint of good farm management practice and conservation of agricultural resources, and to determine the probable effect of desirable adjustments on farm income. Data accumulated in the past years, as well as much definite new in-

formation affecting each argicultural area of the state were used in furthering this project. The material from this research, together with similar data from the researches of the other states, made possible the presentation, for the first time, of regional conditions and the adjustments which sound farm practice will bring about. The preliminary work of this project was completed during the year, but much additional work will be required. The results thus far obtained from this study were presented to the various counties of the state, so that the farmers might develop a plan of agriculture for their respective counties and adapt the information to the farm management practice necessary for their farms.

The buildings available to the Experiment Station are inadequate to meet the demands for office and laboratory space. The various programs of work, especially those in cooperation with the Federal Government, require greatly increased personnel, with the result that offices originally designed for one or two persons are occupied by five to ten persons. Laboratories are much overtaxed, particularly the public service laboratories. Space for the storage of valuable documents and records is insufficient and the overcrowded condition of the offices necessitates the use of the basement rooms for offices. To alleviate these conditions, a building program is proposed which will practically double the capacity of the present Experiment Station building. Laboratories and greenhouse space will be provided for the very important studies in tobacco curing and tobacco diseases contemplated under the new funds made available by the Bankhead-Jones Act.

In 1935, a new sheep barn was constructed. It contains necessary facilities for the conduct of more effective experimental work with sheep and provides for the flock used in resident instruction and for exhibition. A barn was reconstructed for the young stock on the dairy farm. Another barn, which had become obsolete and in a bad state of repair, was razed and the timber used for other construction. A barn in which to conduct curing experiments with dark tobacco was erected at the Western Kentucky Substation. These barns represent the first minor building program which has occurred during the past five years.

The agreement with the Tennessee Valley Authority for the conduct of experimental work with soils, particularly as affected by phosphates, was continued. Tests were made of the availability of ordinary superphosphate, monocalcium-, dicalcium-tricalcium phosphate and finely ground Tennessee rock phosphate. These experiments are supplemented by phosphate tests in rotation of crops at 11 different places in the state and cover the use of 980 plots. The determination of the effect of top-dressing clover and alfalfa has required the use of 144 plots in 8 different locations in the state.

Apparently the activities pertaining to the agricultural adjustment program have served to apprise a larger number of farmers of the work of the Experiment Station. Increased demands have been made upon the Experiment Station for information in the various fields of agriculture and for assistance from the various other types of service available. The demands upon the public service laboratories have been especially heavy and far exceed the funds made available to these laboratories from the state. During the year, in the bacteriological laboratory, 187,898 examinations were made; 1,223 in the food labatory, and 282 in the drug laboratory, a total of 189,403, an increase of nearly 40 percent over the total examinations made last year.

The fiftieth anniversary of the establishment of the Kentucky Agricultural Experiment Station was observed September 25, 1935, with appropriate ceremonies. A copy of the program is given herewith:

PROGRAM

FIFTIETH ANNIVERSARY

*of the*

Kentucky Agricultural Experiment Station

Wednesday, September 25, 1935

10:00 to 12:00 A. M.

Visits to Experiment Station buildings and Experiment Station farm. Members of the staff will accompany visitors.

*Recess*

Memorial Hall Ampitheatre

2 P. M.

PRESIDENT FRANK L. MCVEY, *Presiding*

Invocation . . . . . *Rev. T. C. Ecton*

Half a Century in Retrospect . . . *Dean Thomas Cooper*

As the Farmers View the Experiment Station . . . . *Senator Perry B. Gaines*

Melville Amasa Scovell—Founder and Builder . . . . . *Professor George Roberts*

Joseph Hoeing Kastle, Director 1912-1916 *Dr. G. Davis Buckner*

Agriculture and Science . . . . . *Dr. F. B. Mumford*
Dean and Director, College of Agriculture, University of Missouri

Music Announcements

Benediction

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During the past fifty years, the Experiment Station not only acquired physical facilities of value, but made great progress in the development of its researches. A review of work accomplished in this period as a result of the Station's researches reveals actual benefits accruing to the people of the state thru the improvement of agriculture and livestock of the state. Many of the discoveries of the Kentucky Experiment Station were not only of regional value, but advantageous to the agriculture of the United States. It is of interest to note that certain of the practices recommended by this Experiment Station were adopted in foreign countries as well. The contributions of the Kentucky Experiment Station in chemistry, agronomy, soils, plant breeding, animal pathology and animal husbandry were of special importance and many of them are fundamental to agricultural advancement.

The varied activities of the Experiment Station are presented briefly in this report. Results of work and detailed reports of research projects are issued from time to time in bulletins and circulars which are available upon request.

*Adjustments in Agricultural Production.* A study was conducted with the cooperation of the U. S. Department of Agriculture, to determine what changes in farming practices are necessary to conserve soil fertility and prevent erosion.

In 1929, 1,446,000 acres of land in Kentucky were reported as idle or fallow, a large part of which presumably was left bare thru the winter, a period of severe leaching. To reduce erosion such land should be seeded in the fall to a cover crop such as wheat, rye, winter oats, or winter barley.

According to the census of 1929, approximately 29 percent of the tillable land in Kentucky was devoted to intertilled crops such as corn and tobacco, and 54 percent to hay and rotation pasture. A reduction of intertilled crops with a consequent devotion of about two-thirds of the land to hay and pasture, it is thought would do much to conserve the soil resources of the State.

Under Kentucky conditions the growing of tobacco is considered less injurious to the soil than the growing of corn because tobacco is harvested earlier than corn and a winter cover crop can be sown immediately. Tho for economic reasons such as failing markets, accumulated surpluses and the like, there may be justification for reducing tobacco acreage in the State, there appears to be no physical necessity for doing so. Reduction in the acreage planted to corn would be more effective in maintaining soil fertility and preventing erosion than reduction in the acreage of tobacco. It seems advisable, therefore, that the acreage of tobacco in Kentucky be maintained at the highest point which market conditions will justify and that the acreage of corn should be reduced approximately 30 percent in the State as a whole.

In order to maintain soil fertility and to prevent erosion, somewhat longer crop rotations than are now practiced in Kentucky seem advisable. To assure grass crops which will prevent erosion satisfactorily, more ground limestone and fertilizer must be used than is now customary. If these practices are followed, it is believed that yields per acre of most crops will be increased and that the quality of pastures will be improved sufficiently to permit an increase in the number of livestock, particularly of the classes which utilize hay and pasture.

A satisfactory practice in Kentucky is to sow small grain in the fall and seed the land to grasses at the same time, or to sow grasses and clover the following spring. Frequently, the

small grains furnish considerable winter pasture and some pasture is afforded thru the following season if no grain crop is to be harvested. An extension of this practice thruout the State, together with increases in the acreage of harvested grain, should support a considerable increase in the number of livestock. It is considered possible to support increases of approximately 40 percent in dairy cows, 200 percent in beef cows, 50 percent in sheep, and 30 percent in poultry, if these practices are carried out.

*Part-Time Farming.* The study of part-time farming was undertaken in connection with the problem of the rehabilitation of families living on submarginal land. One proposed solution of this problem is the locating of families on small tracts of land accessible to opportunities for outside employment, the farm to furnish a home and subsistence goods and in many cases some cash income above expenses, a major or minor part of the income at the same time being furnished by work away from the home place.

The data on 433 families doing part-time farming were analyzed to determine the most important factors for the success of part-time farming as a means of making a livelihood. A report on white families doing part-time farming was published in Bulletin No. 358.

The analysis of the data on 104 Central Kentucky colored families in the part-time farming study was completed and a manuscript prepared for publication. On an average, each of these colored families operated a tract of only 2.9 acres. Seventy-eight of the 104 tracts were smaller than 2.5 acres. The total income of the 104 operators averaged $399, of which $192, or 48 percent, was obtained from work done off the farm. After expenses were deducted the average operator earned $81 net from his tract. These net earnings, plus $204 outside income, resulted in total labor earnings of $285 per operator.

The greatest advantage of part-time farming appeared to be in reduced food and living costs rather than in increased cash earnings. The security offered during periods of unemployment was shown to be an important factor in attracting families whose employment was seasonal or whose positions were insecure.

*Population Growth in Relation to Land Use and Relief.* As a part of the research project dealing with families living on submarginal land a study was made to determine the effect of population growth in relation to the land-use program of the state. The ratio of children under 5 years of age per 1,000 females 15 to 44 years of age, was used as a measure of the natural increase of the population. In five of the counties—Jefferson, Fayette, Campbell, McCracken and Kenton—all of which have good sized cities, it was found that the population was not reproducing itself tho the rural population in these counties showed a substantial natural increase. In the mountain counties the rate of increase is such that if no migration were to take place the population would double in from 25 to 40 years.

As an example of the effect of population increase as related to land-use programs, it was found that the average gain per year for the 27 mountain counties in Eastern Kentucky, measured by excess of births over deaths, was 12,500 persons. The excess as measured by the ratio of children under 5 years per 1,000 females 15 to 44 years of age, was 10,500 persons per year. These data show the rapidity of the population growth in the mountain section of the state.

*Delinquency of Farm Real-Estate Taxes and Assessment of Farm Land.* A manuscript was prepared of a study of farm real-estate tax delinquency for six years (1928-1933). Conclusions based upon findings of this study are: (1) That at least one-third of the counties in Kentucky have insufficient wealth to maintain adequate governmental services, and that this condition is further aggravated by the operation of a classified property tax law by which much of the taxable property within counties in taxed only by the State; (2) That much of the farm land in Kentucky is now being used for purposes to which it is not suited, and that long continuance in its present uses, will deplete the soil and impoverish the people living therefrom; and (3) That small farms were more often tax delinquent than large farms, an implication, among other things, that possibly these farms are over-assessed and so disproportionately taxed.

A special study was made of farm land assessments preparatory to working out not only an acceptable and equitable

method of assessing farm land, but incidentally to disclose existing maladjustments in present assessments and to test present assessment methods and practices against sound methods and practices.

Tentative conclusions indicate that assessed values of farm land are relatively higher in some counties than in others; that sales prices of farm land are generally higher than the assessed values of the same land; that the assessed values of farm land more nearly equal the sales prices during years of depression; and that assessment methods and practices vary among the counties despite state statutory and constitutional requirements to the contrary.

*Prices of Kentucky Farm Products in Recent Years.* Data on stocks of all Kentucky types of tobacco in the hands of dealers and manufacturers were adjusted for loss of weight in stemming and redrying according to factors used by the United States Department of Agriculture. This permits the calculation of total supplies and annual disappearance currently in such a way as to agree with statements issued in Washington.

Turkeys are becoming an important source of income for Kentucky farmers. From a study of the farm price of Kentucky turkeys it was found that these prices are directly affected by the size of the United States crop of turkeys. During the past eleven years an increase of 500,000 turkeys in the United States crop reduced the farm price of Kentucky turkeys an average of 1.1 cents per pound, live weight, when the influence of the general price level was eliminated. A negative coefficient correlation of .94 is found between the number of turkeys in the United States and Kentucky prices, when correction is made for the small number of years in the study.

More complete data than heretofore available, by which to measure geographical variation in tobacco prices, were obtained from marketing cards on which are indicated the sales of tobacco by individual growers who cooperated with the AAA programs. Sample prices from each community in the more important burley counties are being tabulated. It is hoped to derive a sample pattern of tobacco prices for the state from these tabulations.

*Fruit and Vegetable Marketing.* Last year, at the request of

fruit and vegetable growers in the vicinity of Louisville, a study of the organization and operation of the market was started. The volume of fruits and vegetables marketed in Louisville increased steadily in recent years. Three important factors are responsible for this growth. They are (1) increased local consumption of fruits and vegetables, (2) local production of fruits and vegetables above the requirements of local consumption, and (3) development of faster and more mobile transportation, especially of motor transportation. A full appraisal of the market cannot be made at this time altho certain tentative conclusions have been reached.

*Study of Farm Businesses.* The chief purpose of this study of 323 farms was to disclose the factors most influential in the profitableness of farming in the 9 areas in which the farms were located.

One striking fact was the great variation in the net earnings made by the different operators which was a result of their year's labor and management. For example, the net earnings of 72 farm operators situated in the outlying Bluegrass counties varied from $—91 for the operator who made the poorest financial showing to $4,161 for the most successful operator.

The analysis of these studies in farm management showed that the most important factors influencing farm profits were: (1) high gross sales per acre operated; (2) low expenses per acre operated; (3) labor efficiency as indicated by the productive work units accomplished per man; (4) acreage of tobacco and high quality tobacco; (5) yield of corn per acre; (6) yield of tobacco per acre; (7) receipts per sow; (8) receipts per ewe; (9) receipts per $100 invested in beef cattle; (10) percent of pigs raised; and (11) percent of lambs raised.

The farms were classified according to the number of these factors in which they were strong; that is, in which they exceeded the average farm. Thus, of 72 farms in the outer Bluegrass region, 16 were strong in not more than three factors. These farms made small net earnings, averaging $922. Forty-three farms were strong in four, five or six factors and their net earnings averaged $1,348. The 11 most efficient farms were strong in seven, eight or nine factors and made the highest net earnings, averaging $1,714.

This analysis for this group of farms and the similar calculations for groups of farms in other important agricultural sections indicate the importance of a well-balanced farm business. They show that high crop yields alone or high-yielding livestock or high-priced tobacco do not determine profits. If a farm is strong in most of the factors of efficiency, it is almost certain to return a profit.

*Types of Farming.* During 1935 additional work was done on the study of types of farming which was carried on during the previous two years. The research project in agricultural adjustment undertaken in the spring of 1935 emphasized the importance of type-of-farming data to the agricultural problem. This fact pointed to the desirability of refining type-of-farming data already on hand.

*Arsenic Content in Animal Tissue.* Further investigations show that arsenic is a normal constituent of the animal body and occurs in larger quantity in the blood than elsewhere in the body. An experiment was conducted to ascertain the effect of different levels of arsenic compounds on the growth of albino rats and chickens, and the accumulation of this element in the tissues. Twenty-four young rats were separated into four groups of 6 each and fed the following rations for 6 weeks:

| | | |
|---|---|---|
| Group 1. | Basal stock ration, | no added arsenic |
| " 2. | " " " | 25 ppm of arsenic in the form of $As_2O_3$ |
| " 3. | " " " | 250 ppm of arsenic in the form of $As_2O_3$ |
| " 4. | " " " | 250 ppm of arsenic in the form of sodium |
| " 5. | " " " | etharsenol |

If arsenic caused a significant deviation from normal growth, it was a slight stimulation rather than a retardation. The arsenic concentration in the blood in each of the four lots of rats was greater than in any of the other tissues analyzed. The arsenic content of the blood of the rats fed 250 ppm of arsenic in the form of arsenic trioxide was 500 times that of their litter mates which were fed the basal ration only, yet the animals which received arsenic appeared normal in every respect. The concentration of arsenic in the blood, spleen, lungs, liver and kidneys of the rats fed appreciable amounts of this element was relatively high, whereas in the muscle, brain, stomach and

pelt the concentration was relatively low. Arsenic administered in the form of arsenic trioxide, was stored to a much greater extent than when given in the form of sodium etharsenol. Individual hemoglobin determinations made at weekly intervals thruout the experiment failed to reveal any significant effect of arsenic on hematopoiesis. The femurs, tibiae, radii and ulnae were composited and analyzed. Arsenic feeding had no significant effect on the total ash, calcium, phosphorus, magnesium or carbon dioxide content of the bone.

Twelve young rats averaging about 75 gms. were each fed 15 mgs. of lead arsenate. These rats were killed in pairs, 1, 2½, 5, 12, 24, and 48 hours after dosing. Samples of blood, spleen, heart, lungs, stomach, liver, kidneys, brain, muscle, skin, and hair were analyzed for arsenic. Absorption of arsenic began within 1 hour after the administration of lead arsenate. The blood, spleen and lungs contained the greatest concentration of arsenic. Arsenic did not appear in the brain in appreciable quantity until 24 hours after its administration. Forty-eight hours after dosing the order of concentration in the tissues was blood, spleen, lungs, kidneys, heart, liver, stomach, brain, muscle, skin and hair.

Eighty Rhode Island Red baby chicks were divided at random into four lots of 20 chicks each and were fed the following rations for 8 weeks: Lot 1: Basal ration, no arsenic added; Lot 2, Basal ration, plus 25 ppm of arsenic in the form of $As_2O_3$; Lot 3, Basal ration plus 250 ppm of arsenic in the form of $As_2O_3$; Lot 4, Basal ration plus 250 ppm of arsenic in the form of sodium etharsenol.

The average weights at 8 weeks were 582, 527, 328 and 543 gms., respectively, for lots 1, 2, 3 and 4. Two hundred and fifty ppm of arsenic in the ration in the form of arsenic trioxide very markedly retarded growth. The feathers of the chicks which received feed containing 250 ppm of arsenic in the form of arsenic trioxide were uniformly lighter in color than those of the other three lots. The concentration of arsenic in the feathers was greater than in the blood or any of the other tissues analyzed, and the feathers of the chicks which received feed containing 250 ppm of arsenic as arsenic trioxide contained 145 times as much as did those of the normal control

lot. The accumulation of arsenic in the blood, spleen, heart, lungs, liver, kidneys and brain of chicks was almost nothing as compared to the amount of this element found in the same tissues of rats when the two species are fed rations containing the same amount of arsenic. For example, the blood of rats and chicks when these two animals were fed rations containing 25 ppm of arsenic as $As_2O_3$ contained 1,300 and 4 ppm of arsenic respectively. On the other hand, the concentration of arsenic in the feathers and skin was somewhat greater than in the pelt of the rat. Arsenic had no appreciable effect on hemoglobin formation.

*The Effect of Boron on the Growth of Rats.* Twenty-four young rats were divided into 6 groups of 4 each. Group 1 received the basal ration only and the other 5 groups received the basal, plus .0025, .01, .05, .10 and .50 percent boron in the form of boric acid. The rats receiving .50 percent boron survived, on the average, only 12 days and showed an average loss in weight of 32 gms. They were very emaciated. Autopsy showed a very severe enteritis, the small intestines filled with a bloody liquid, the liver, spleen and kidneys very dark brown, almost black. None of the rats receiving .10 percent boron succumbed within 9 weeks, tho their growth was markedly retarded. The rats receiving .05, .01, or .0025 percent boron have shown no ill effects thus far. The experiment is being continued to determine the effect of boron on reproduction and also to ascertain whether boron will pass the placental circulation.

*Spectroscopic Method for Determination of Boron.* The procedure has been refined to compare the spectrum of an unknown solution with a known. The flame is developed by saturating natural gas with $Me_3BO_3$ and burning in an oxygen blast. Greater sensitivity is attained and the determination of much smaller quantities is possible. Tests so far indicate that simplicity and greater accuracy may be obtained by reducing the light from the standard burner to match the unknown, by polarization and partial reflection by the use of Nicol prisms.

*A New Indicator for Fluorine.* Thorium alizarine sulfonate, was tested and found superior to ferric thiocyanate. It allows the use of a .00001 gm. per ml. standard.

*The Effect of Minerals on the Growth of Plants.* Forty-two pot

culture experiments with tomato plants, in the greenhouse, were conducted with a badly depleted, unproductive soil, to ascertain if the soil was deficient in the minor as well as the major elements. No fruit was produced where only calcium carbonate was added. Approximately one kilogram of fruit was harvested from the pots to which only the major elements were added, whereas approximately three kilograms were harvested from the same number of pots to which both the major and minor elements were added. This experiment shows very conclusively that the soil was deficient in the minor elements as well as the major elements.

The effect of copper on geraniums was studied. Copper-treated plants produced 6 to 10 blooms until midsummer, then seemingly ceased growth. Untreated plants failed to produce blossoms and made much less growth than the treated plants.

Inconsistent results were obtained in a test of copper on corn. No treated plant failed to tassel and produce pollen. However, some of the untreated plants tasseled and produced pollen. No copper could be found in the ash. A further variation from the continued growth of corn in the same sand was that some cultures produced plants which formed grain on the tassels. Experiments are under way to ascertain the effect of titanium, thorium, tellurium and vanadium as possible factors in the variations developed in the corn and geranium cultures.

*The Effect of Potassium Iodide on Corn.* Seven corn plots of 60 hills each were given treatments of different amounts of potassium iodide at different times during the growing season, as soil additions and as injections into the plants. Four plots of 45 hills each also received flourine, bromine and manure. Applications of 2.5 gm. of potassium iodide or more per hill at the time of planting were toxic; 2.0 gms. per hill were slightly toxic in the presence of manure. Injections of .1 gm. either into the stalk or ear were toxic. The injected iodide produced toxic effects in all parts of the plant, regardless of the point of injection. Addition of 5 gms. potassium iodide to the soil in 10 equal applications thruout the growing period effected slight toxicity during the milk stage. Addition of 2.5 gms., in this manner, showed practically no toxicity. The plants treated matured earlier than the controls except when manure was also

added. Addition of bromine, flourine and iodine not in excess of 2 gm. per hill increased yield of grain over the controls. Toxicity from small treatments was shown by marginal chlorotic spots on the leaves, noticeable by transmitted light. The spots increased in size with the degree of toxicity and extent of growth, often forming streaks. Later they became necrotic and turned brown. Heavy applications at time of planting caused very low germination (about 2 percent) and also affected the replants (app. 5 percent). Plants that did grow showed the leaf symptons very early and were badly stunted at maturity. Excessive quantities of potassium iodide greatly reduced fertilization of the ears. Toxicity was shown in all cases by the production of ears which contained a few large rounded grains.

*Effect of Iodine on Plant and Animal Life.* Potassium iodide was added to soil in the field and corn was grown on the treated and untreated soil. The iodine content of the corn grown on the treated soil was several times that of the corn grown on the untreated soil. A feeding experiment with ten rats was conducted with portions of the high and low iodine corn. The rats on the corn that contained 1.2 ppm of iodine gained 80 grams in 11 weeks while those on the check corn (0.2 ppm iodine) gained 70 grams in the same time. The rats did not make normal growth on corn alone, therefore dry milk powder was added to the diet on the sixth week. The animals did not reproduce. The average basal metabolism ratio for the rats on the iodized corn was 6.03, and those on the check corn diet, 5.42.

A further experiment was started on September 10, 1935, to ascertain the effect of feeding inorganic and organic iodine compounds on the growth of young white rats. Thirty-six animals were used in this study. The purified ration used was composed of corn starch, casein, sugar, butterfat, salt mixture, alcoholic extract of Squibbs autolyzed liver concentrate and extract of wheat middlings and bran. The iodine content of this purified diet was about 53 ppb. The first part of the experiment lasted for 12 weeks. All the animals, except the controls, received 0.2 mg. iodine per day in the various forms. The animals on a very low iodine-intake gained an average of

92 grams, and those on potassium iodide gained 105 grams. The group on iodoacetic acid gained 83 grams and those on b-iodopropionic acid gained 97 grams.

Riodine is a medicinal preparation containing 17 percent of iodine in combination with castor oil. After administration of equal amounts of iodine in the form of potassium iodide and riodine, it was found that the elimination of iodine in the urine of the rats that received iodide reached its maximum in 4 hours, and the greater part of the element was excreted in 48 hours. The corresponding intervals with the iodized oil were 10 hours and 93 hours.

*Iodine and Bromine in Brines.* Iodine and bromine were determined in 16 brines, 4 well and 3 spring waters from seven counties. The iodine content of an artesian well water in Carroll County was 73 ppb. The salt waters examined were from the oil-bearing strata in Eastern Kentucky. The salt waters from Estill County contained about 1/10 as much of these elements as are found in some of the commercially workable oil brines. One sample from a well 800 feet deep in Estill County countained 3.2 ppm of iodine and 228 ppm of bromine.

*Iodine in Vegetables.* The iodine content of some vegetables, grown in the field, with and without the addition of potassium iodide to the soil, was determined. The following findings are calculated as parts per million of the material dried to constant weight: Strawberries, 0.554; cabbage, 1.70; corn, 0.30; onion tops, 800.; onion bulbs, 400. (iodized); radish tops, 30. (iodized); turnips, 1.70; turnips, 0.59; Irish potatoes, 1.40; (iodized); Irish potatoes, 1.50 (iodized); Irish potatoes, 0.30 without iodide.

The Irish potatoes grown with iodide were free from scab, whereas untreated potatoes grown nearby were not.

*Iodine in the Thyroid Gland.* Seventeen human thyroids were analyzed for iodine. All were goitrous. The average iodine content was 0.053 percent, calculated on the oven dry, fat free material. The largest percentage of iodine found in any gland was 0.108, and the smallest, 0.027. From published analyses of the thyroids of normal humans and normal horses, sheep, pigs, rats and beef cattle, it appears that the human thyroids analyzed in this study contained less than one-third the

percentage of iodine found in the normal glands of humans, and domestic animals.

*Soil Experiment Fields.* The results of experiments on the outlying soil fields continue to emphasize the fundamental importance of the use of lime and phosphate and legumes in economically increasing productivity. If these practices were universal in the State, the present production of harvested crops could be achieved on two-thirds to one-half the present acreage, permitting a very great extension of land for pasture. With good soil management practices, two-thirds of the farm land of Kentucky could be kept in grass and legumes for hay and pasture.

The crop yields on the outlying experiment fields for 1935 are given in the following table:

| | Corn, Bus. | | | Wheat, Bus. | | | Hay, Lbs. | | |
|---|---|---|---|---|---|---|---|---|---|
| | O | M | MLP | O | M | MLP | O | M | MLP |
| Berea | 15.7 | 16.7 | 35.3 | — | — | — | 2616 | 4810 | 12,740 |
| Fariston | 8.0 | 6.9 | 51.1 | 00 | 00 | 5.2 | 000 | 000 | 12,460 |
| Campbellsville | 23.4 | 36.0 | 71.6 | — | 1.7 | 10.7 | 1340 | 2780 | 6,910 |
| Greenville | 14.0 | 35.6 | 64.6 | 1.7 | 6.5 | 24.7 | 4665 | 6725 | 13,010 |
| Mayfield | 10.7 | 31.7 | 56.9 | 2.3 | 7.5 | 18.2 | 6570 | 7940 | 11,910 |

O means no fertilizer; M, manure; MLP, manure, limestone and superphosphate.

Manure, where used, is applied at a rate equal to the weight of the crops removed, except in the case of wheat grain. No limestone has been used since 1923 except on the Berea field which had an application of 1 ton an acre. Superphosphate has been used at the average rate of 100 pounds an acre a year for the past few years. Prior to this the rate was 200 pounds. The Campbellsville field has a rotation of corn, wheat, and mixed grass and legumes for a third-year crop. The other fields have a four-year rotation, hay covering two years. At Berea, rye is used. The hay yields are totals of all cuttings.

Tobacco is grown in a six-year rotation, with wheat, legumes and bluegrass. Five tons of manure is used on all plots at Campbellsville and Mayfield. No limestone has been used since 1923. Prior to this 6 tons an acre were applied at Greenville and Mayfield and 4 tons at Campbellsville. Injurious effects from this liming have not entirely disappeared. Bulletin 322 gives rates

of fertilizer application. Tobacco yields on three fields for 1934 follow:

| | Pounds an acre | | | | Value an acre—dollars | | | |
|---|---|---|---|---|---|---|---|---|
| | O | LP | LPKN | PKN | O | LP | LPKN | PKN |
| Campbellsville .. | 1132 | 1380 | 1624 | 1562 | 119 | 215 | 305 | 275 |
| Greenville ..... | 751 | 1379 | 1675 | 1697 | 39 | 166 | 161 | 270 |
| Mayfield ..... | 1198 | 1492 | 1709 | 1611 | 75 | 95 | 100 | 105 |

O means no fertilizer; L, limestone; P, superphosphate; K, sulphate of potash; N, sodium nitrate.

*Residual Effect of Superphosphate and Rock Phosphate.* In 1930, certain plots on the Berea, Greenville and Mayfield soil experiment fields were divided. Some of these plots had been regularly fertilized since 1913 with superphosphate at the average rate of 160 pounds an acre yearly, and some with rock phosphate at twice this rate. The rotation was corn, wheat, and two years of mixed legume and grass hay (rye at Berea). Six comparisons were made of the continuance and omission of superphosphate, and the same number for rock phosphate. The average yields for this period and the 1935 yields follow:

| | Superphosphate | | Rock phosphate | |
|---|---|---|---|---|
| | Used | Not used | Used | Not used |
| Corn, bus., average of 11 crops ..... | 54.1 | 52.8 | 56.8 | 57.6 |
| " " 1935 yields ..... | 52.3 | 50.8 | 56.8 | 58.2 |
| Wheat, bus., average of 10 crops ..... | 21.3 | 19.1 | 21.1 | 21.1 |
| " " 1935 yields ..... | 21.5 | 14.8 | 19.9 | 19.5 |
| First-year hay, lbs., average of 12 crops .. | 3733 | 3464 | 4336 | 4284 |
| " " " " 1935 crops ..... | 4813 | 4508 | 5333 | 5173 |
| Second-year hay, lbs., average of 9 crops .. | 4682 | 4529 | 4952 | 4912 |
| " " " " 1935 crops ..... | 4848 | 4787 | 5231 | 5309 |

In the first-year hay crop there were 19 cuttings on the three fields, and for the second-year hay, 15 cuttings. These tests show the value of residue phosphorus left in the soil from both forms of phosphate. Resultant crop increases were large on all fields except Mayfield, where corn showed no marked increase. The tests will be continued.

*The Effect of Liming on Availability of Rock Phosphate.* Comparing the rock phosphate treatment and the limestone and

rock phosphate treatment in the corn, wheat, legume rotation at Campbellsville, it was found that for the first two-thirds of the experiment, crop yields were lower where limestone was applied with rock phosphate than where rock phosphate was used without limestone. From 1919 to 1930, 1,200 pounds of rock phosphate an acre each rotation were used, and 600 pounds since. Four tons an acre of ground limestone were used between 1919 and 1923. Beginning with 1931, the hay and the succeeding crops of corn and wheat showed a reversal of this, as indicated in the table which follows. The average yields of crops are shown for the periods when the depressing effect of limestone was at its height and for the period since the depressing effect disappeared.

| | Hay (all cuttings) Lbs. | | Corn, Bus. | | Wheat, Bus. | |
|---|---|---|---|---|---|---|
| Treatment | Middle 5 crops Begin 1926 | Last 5 crops Begin 1931 | Middle 4 crops Begin 1927 | Last 4 crops Begin 1932 | Middle 3 crops Begin 1929 | Last 3 crops Begin 1933 |
| O | 2022 | 3108 | 34.8 | 43.9 | 9.0 | 5.6 |
| RP | 5287 | 6014 | 54.2 | 61.8 | 17.7 | 14.6 |
| LRP | 3780 | 6329 | 46.3 | 61.7 | 16.7 | 16.7 |

O means no fertilizer; RP, rock phosphate; LRP, limestone and rock phosphate.

*Phosphorus Availability Studies.* In cooperation with the Tennessee Valley Authority, the availability of ordinary superphosphate, monocalcium phosphate, dicalcium phosphate, tricalcium phosphate, and finely ground Tennesse Rock phosphate was tested on untreated soil from the Campbellsville and Mayfield experiment fields. The tests were made with Turkish tobacco followed by rye, and with red clover both with and without the addition of ground limestone. The relative availability of the phosphates was about the same to the three crops. Superphosphate, monocalcium phosphate and dicalcium phosphate were about equally available; tricalcium phosphate was less available than these, and rock phosphate considerably less available. Liming increased availability of superphosphate, monocalcium phosphate and dicalcium phosphate, but, in general, decreased availability of tricalcium phosphate and rock phosphate.

It was found more effective to place monocalcium and tri-

calcium phosphates in a layer than to mix them with the soil. The average percentage recovery of monocalcium phosphate was 39.1 when it was placed in a layer, and 23.6 when it was mixed with the soil; recovery of tricalcium phosphate was 15.2 percent when it was placed in a layer and 9.5 when mixed with the soil.

*Rock Phosphate Stays in the Top Soil.* Phosphorus was determined in soil from the plots in the phosphate tests and in the general fertilizer tests at the Campbellsville soil experiment field. The heavier applications of rock phosphate have built up a large reserve of phosphorus in the surface soil, as shown by the analyses. Analyses of the subsurface soil do not show any movement of phosphorus from the plow layer into the soil below.

*Nitrogen in the Soil as Affected by Cropping Practices.* At the end of the summer of 1934, large growths of Korean lespedeza were present in six of the lysimeters used in this study. The table shows the method of handling this crop in the duplicate lysimeters and the leaching of nitrogen from the lysimeters (average of duplicates).

| | Pounds nitrogen leached per acre | |
|---|---|---|
| | Oct. 1, 1934, to Mar. 31, 1935 | April 1,1935, to June 30, 1935 |
| Korean lespedeza undisturbed ..... | 34.86 | 21.26 |
| Korean lespedeza disked into 2 to 3 inches of soil, Sept. 13, 1934 ..... | 96.99 | 29.61 |
| Korean lespedeza disked as above and rye cover crop seeded ..... | .29 | 1.86 |
| Not cropped ..... | 163.64 | 20.49 |

Determinations made at different times in the fall of 1934 showed not over 15 pounds of nitrate nitrogen per acre in the soil in plots where Korean lespedeza had grown during the summer preceding the sampling and where the crop had not been pastured or cut for hay. Nitrate nitrogen was also determined in the fall of 1934 and winter of 1934-35 in the soil of plots into which lespedeza had been disked September 14, 1934; on January 7, 1935, the average amount was 46.1 pounds

per acre. In plots where a rye cover crop was seeded after disking, practically no nitrate was found during the fall or winter.

The percentage of the total nitrogen in Korean lespedeza plants (tops only) was 85.1. The percentage of total dry matter in the tops was 81.3. Determinations were made of dry matter and nitrogen in different parts of the tops of the Korean lespedeza crop. The results, expressed as pounds per acre, are:

| | Stems | Green leaves | Dead and fallen leaves | Total |
|---|---|---|---|---|
| Dry Matter | 2506 | 2899 | 605 | 6029 |
| Nitrogen | 30 .8 | 89 .0 | 13 .0 | 132. 8 |
| Nitrogen, percent | 1.23 | 3 .07 | 2 .14 | |

*Rotation Experiment with Tobacco.* Superiority of manured plots was the main feature. In the tobacco, wheat, and clover and orchard grass rotation, tobacco on manured plots averaged $233 an acre value. In the same rotations with commercial fertilizers (500 lbs. of 4-8-4 analysis), it brought $211, and with neither manure nor fertilizer, $201.40.

*Rate-of-Liming Experiment on Tobacco.* In the 1934 tobacco test the average value of the leaf where the rate of liming was very heavy was about two-thirds that on the unlimed or lightly limed plots. In 1934, 4,000 pounds of ground limestone an acre affected quality injuriously to a slight extent, but very serious reduction in quality did not occur until the rate reached 10 tons an acre. The most unexpected result of heavy applications of limestone was the injurious effect upon red clover. In 1935, red clover on plots given a moderate application of limestone yielded 50 percent more than that on the heavily limed plots. Corn yields were slightly reduced by very heavy applications of limestone; wheat apparently was not affected.

*Nicotine Content of Tobacco.* About 300 samples of burley tobacco grown on the Experiment Station farm were analyzed for nicotine. The results indicate that it is possible to produce a type of burley tobacco low in nicotine. On the other hand, analyses of a few samples of dark tobacco indicate that

it is possible to produce a variety that contains twice as much nicotine as is usually found in dark tobacco.

Analyses of 10 of the most popular brands of cigarettes found on the market show an average of about 2 percent nicotine. Accordingly it appears feasible to produce a burley tobacco that contains a much smaller percentage of nicotine than was found in these cigarettes. Such a type of burley tobacco should have considerable commercial possibilities for the manufacture of cigarettes.

*Control of Insects Injurious to Tobacco Plants in the Beds.* The control of soil insects by burning the tobacco bed was observed. White grubs and garden centipedes, wrapped in cheesecloth, were placed in the soil in the bed to depths of 2 to 8 inches, just before the bed was burned. The day after the bed was burned, the specimens were examined. The soil was rather moist at that time.

The percent of grubs killed at different depths was: 3 inches, 100; 4 inches, 95.2; 6 inches, 60; 8 inches, 10. The percent of garden centipedes killed was: 3 inches, 100; 4 inches, 90; 6 inches, 35; 8 inches, 5.

A test was made of the effect of fumigation with carbon disulfide on larvae of green June beetle. On April 24, 90 square yards on one tobacco bed were treated by placing the liquid in the soil to a depth of 4 to 8 inches, by means of a large pipette. One teaspoonful of the liquid was used for each dose, and from 0.4 to 1.5 ounces were applied to one square yard, depending upon the number of exit holes made by the larvae. As nearly as could be determined, 97 percent of the larvae were killed by the treatment.

Several insecticides were used to control the tobacco flea beetle in beds. Also, portions of beds were enclosed by board frames covered with tobacco cotton, to exclude insects. The insecticides used were: (1) barium fluosilicate dust; (2) Bordeaux mixture, 3-4-50 formula with 2 pounds of lead arsenate; (3) the same as (2) with 1 pint of a 40 percent solution of nicotine sulfate; (4) cuprous cyanide, 2.5 pounds in 100 gallons of water.

The barium fluosilicate dust containing 80 percent of barium fluosilicate and 20 percent of inert matter gave the best

protection against flea beetle injury. Where this insecticide was used, 13.3 percent of the plants were injured by the beetles. The plot sprayed with Bordeaux mixture and lead arsenate showed 20 percent of the plants injured, and the plot sprayed with Bordeaux mixture, lead arsenate and nicotine sulfate, 15.5 percent. The plot sprayed with cuprous cyanide had 25.8 percent of the plants injured by beetles and the unsprayed plots 31.4 percent (average of 2 plots). The plants protected by a board frame banked on the outside with soil and covered with tobacco cotton were by far the least injured by the flea beetle. In this plot, only 1.5 percent of the plants showed beetle injury.

A species of springtail was found doing considerable injury to very small tobacco plants during the first week of May. The insect was controlled by spraying with nicotine sulfate diluted with water to make a ½ percent solution.

*Control of Wireworm Injury to Tobacco Plants.* Wireworms were present in the soil in considerable numbers, as was determined upon examination of roots and stems of tobacco plants several days after they had been transplanted. Several practices were tried to observe their effect on wireworms and their injury to tobacco plants. These tests will have to be repeated several seasons before definite conclusions can be reached.

Fall plowing is frequently recommended for controlling certain soil insects, including wireworms. Tests this season showed that 38.4 percent of the tobacco plants in a plot plowed late in the fall of 1934, were injured by wireworms, whereas in an adjoining plot plowed in the spring of 1935, 33.1 percent were injured. The percentages of injured plants were 25.8, 26.5, 24.2 and 14.5 in plots set May 30, June 6, June 13 and June 20, respectively. Of plants on ridges, 19.2 percent were injured as against 29.2 percent of those set in furrows, a difference of 10 percent in favor of setting the plants on ridges.

Cultural practices, such as plowing, harrowing and disking have been recommended to control wireworms. In the spring of 1935, two plots were given five diskings before planting the tobacco in addition to the usual preparation. One plot was stirred to the depth of 2 inches, the other to the depth of 4

inches. It was found that 34.8 percent of the plants from the plot which had the shallow cultivation and 27.8 percent of those from the plot which had the deeper cultivation, had been injured by wireworms.

In another test, four strains of white burley tobacco, Ky. 5, Ky. 7, Ky. 16, and Judy, were compared as to injury from wireworms. There was practically no difference in the number of plants of each strain attacked.

Different types of plant ranging in diameter of stem from 4 or 5 m.m. to 8 or 9 m.m. were compared. There was no appreciable difference in the number injured, and the small plants survived injury as well as the large ones. However, with less favorable conditions at transplanting time, the result may be different.

Plants spaced 13 inches in the row and plants spaced one-half this distance were compared as to wireworm injury. Practically the same percentage of the plants were attacked in each case, 23.7 percent for 13 inches and 22.5 percent for 7½ inches.

*Tobacco Extract as a Spreader or Emulsifier in Sprays.* Extracts of tobacco, made by various methods, were tested as spreaders for poisons and as emulsifiers for mineral oil sprays. One water extract treated with a small amount of alkali had about the same spreading and carrying efficiency for liquid poisons as soap. Another extract was a fair emulsifier for coal-tar oil and was used in that combination for spraying rosy aphid eggs. Preliminary tests of tobacco extract mixed with mineral oil indicate that this combination may be useful against the larvae and eggs of codling moth.

*Tobacco Diseases.* Black-shank. Two fields of tobacco were found in Todd County with plants dying from black-shank (*Phytophthora parasitica var. nicotianae*). Both fields had been affected in 1934. This disease had not been recognized in Kentucky before, tho it may not be new to the State.

Anthracnose. This new disease of seedling tobacco in Kentucky was found in plant beds which had been flooded several times with water that had flowed over a pasture in which legumes were growing. It was found to be caused by a com-

mon clover pathogene, *Colletotrichum destructivum* O'Gara. It is not likely to become a common plant-bed disease.

Wildfire. Wildfire appeared in the southern tier of counties in Western Kentucky in destructive form. It had not been reported in several of them previously. It was found for the first time on the farm at the Princeton Experiment Substation.

Angular Leafspot. *Bacterium angulatum* was found to be commonly present in leafspots on smooth ground-cherry (*Physalis subglabrata*). Bits of spots examined were found to be teeming with bacteria. When bits of affected tissue from 39 plants were dropped into separate tubes of broth and these preparations used to inoculate tobacco plants, typical angular leafspot was produced by 37 of them. The collections were made October 31 or later, two months after tobacco was cut. These studies leave little doubt that the angular leafspot organism has at least one wild host. It was demonstrated that both garden flea hoppers (*Halticus citri*) and flea beetles (*Epitrix parvula*) sometimes carried the organism. Transmission of the leafspot bacteria from weeds to tobacco set in the field may explain instances in which clean plants have been found to be affected soon after setting.

*Virus Diseases of Tobacco.* Plants visibly affected with a mild strain of tobacco mosaic were found to be susceptible to a white and yellow strain of the same virus if uninoculated leaves were inoculated with the second virus. The first virus seems to produce no immunity to infection by a second virus if the latter has sufficient uninvaded tissue in which to multiply. A study was made of so-called localization of the tobacco mosaic virus in necrotic spotting varieties and species of Nicotiana. It was found that varieties or species in which localization was supposed to occur, frequently developed systemic infection following the production of local necrotic spots on inoculated leaves, but the systemic disease was always of the necrotic or streak type. Tobacco mosaic developed in tobacco inoculated with cured tobacco known to be 52 years old. The crop from which this tobacco was obtained was grown the year Mayer first described tobacco mosaic. Necrotic ring patterns were found to be a rather common symptom of

several strains of the tobacco mosaic virus if the plants were exposed to a low temperature in the greenhouse during the period of invasion. The patterns were frequently indistinguishable from those of tobacco ringspot.

For the tenth consecutive year tobacco mosaic was almost completely prevented on the Experiment Station farm by having workers wash their hands and by prohibiting the use of barn-cured tobacco while weeding, pulling and setting plants. The few plants which developed mosaic after growth commenced (.12 percent) were removed. Following cutting, there was from 1.4 percent to 3.2 percent mosaic in the sucker growth.

Studies on soil carry-over of yellow mosaic, and mosaic-burn viruses, two strains which are easily recognized, showed that only 3 plants out of 512 became infected with yellow mosaic in a plot in which all were infected with yellow mosaic the year before. Thirteen plants became affected with green mosaic, of which 8 were recognized as mosaic burn, in a similar plot where all plants were affected with mosaic burn the year before. The results are interpreted to mean that in Kentucky mosaic infection from carry-over in roots of the previous crop is very slight and may be disregarded.

When stalks and leaves known to be infected with mosaic were ground, scattered and disked in shortly before setting, infection was as follows:

| | Material added | Percent | | |
|---|---|---|---|---|
| | | Total plants | Yellow mosaic | Moasic burn |
| Rows 1– 4 | Yellow mosaic stalks | 358 | 23.7 | .3 |
| " 5– 8 | None | 369 | 3.5 | .3 |
| " 9–12 | Mosaic burn stalks | 341 | 4.9 | 31.3 |
| " 13–16 | None | 371 | .5 | 1.6 |
| " 17–20 | Mosaic burn and some yellow mosaic leaves | 362 | 7.4 | 41.4 |
| " 21–24 | None | 363 | .8 | 6.6 |

In a topping experiment 94 plants were topped with a knife after contaminating both hands with mosaic virus. No mosaic appeared in the suckers. A second group of 93 plants was

then topped by hand, of which 22 developed mosaic in the suckers.

*Apothecial Development in Sclerotinia Trifoliorum and S. Sclerotiorum.* In attempting to determine the reason for fall production of apothecia of *S. trifoliorum* and spring production of *S. sclerotiorum,* it was found that the former produced stipes in as short a time as 7 days, with an average time of about 18 days, when placed at the proper temperature, while the latter required an average of about 40 days. The optimum temperature for stipe production in *S. sclerotiorum* appears to be somewhat lower than for *S. trifoliorum.* The two species can be easily distinguished if grown at 28°C at which temperature *S. trifoliorum* grows very slowly while *S. sclerotiorum* grows rapidly.

*Anthracnose Resistance of Red Clover.* It has been demonstrated that the red clovers adapted to Kentucky and the Tennessee anthracnose-resistant clover both show considerable resistance to anthracnose, but when the resistant varieties and susceptible varieties were inoculated with *Colletotrichum trifolii* the mortality up to the middle of September was as follows:

| | 1933 | 1934 | 1935 |
|---|---|---|---|
| Kentucky 101 | 84.8 | 75.3 | 43.1 |
| Tennessee A. R. | 88.9 | 81.8 | 59.6 |
| Wisconsin 4 | 95.2 | 93.1 | 89.9 |

These figures indicate that a fairly high degree of susceptibility for the so-called resistant varieties exists. The rate of death was slower for the resistant than for the susceptible variety, however. In 1935 seed from the surviving plants of Kentucky 101 in 1934 was seeded in comparison with the three varieties. Mortality was only 16.0 percent as compared with 43.1 for Kentucky 101. Hence rapid progress may be made in increasing anthracnose resistance of red clover.

*Red Clover.* Adapted varieties of red clover produced about 5,800 pounds of barn hay from two cuttings, whereas 2,000 pounds was the average of unadapted kinds.

*Lespedeza Hay Yield.* In a comparative test at Lexington,

different lespedezas produced from the first year's growth, the following yields of weed-free cured hay an acre: Korean, 4,020 pounds; Kobe, 4,570 pounds; common, 1,410 pounds, and sericea 3,470 pounds.

*Alfalfa Failure.* The 30 varieties and strains sown in 1933 differed in stand, at the end of the year, from perfect to very poor. The Ladak, Turkestan, Hardistan and Arizona common gave the poorest results. Causes of failure are undetermined, as yet, but appear to be similar to those for red clover.

*Analyses of the Fall Growth of Rye, Barley, Wheat, Oats and Bluegrass.* Samples of the grains were taken in November and December, when the plants were 3 inches (wheat) and 10 inches (oats) high. Protein in the water-free material averaged 28 percent (oats) to 33 percent (wheat); silica-free ash, 8.6 (rye) to 10.6 (oats) percent, and phophorus, 0.62 (barley) to 0.78 (rye) percent. Four samples of bluegrass gathered in October and November averaged, in the water-free material: protein, 13.3; silica-free ash, 3.5, and phosphorus, 0.28 percent. From this it appears that grains give fall pasturage twice as rich as bluegrass, in these nutrients. However, the average percentage of water was 74 to 80 in the grains and 65.5 in the bluegrass.

*Wheat.* In 1935, as in 1933 and 1934, bearded or awned varieties of wheat made a record superior to beardless varieties. Kawvale made an especially good yield, and proved above the average in disease resistance. The strain, Kentucky 31-10, a winter-hardy, red-chaff wheat, also proved resistant to lodging, and the grain was of good quality. Twenty-five or 30 bushels of this strain will be available for distribution next fall. Attempts are being made to get strains that are leaf-rust resistant, by crossing several soft winter wheats with Kanred. Similar material has been obtained from the U.S.D.A. Because of the mildness of the winter, no winterkilling occurred in the winter-hardiness nursery tests conducted in cooperation with the Bureau of Plant Industry, U.S.D.A.

*Corn.* Efforts are being made to develop a variety of yellow corn that is productive and sound. Work has been started by crossing and back-crossing some of the best yellow

varieties with white corn, but several years will be required for completion. Among white corns, the Experiment Station strains of Boone County White and Pride of Saline have made the best records. Woodburn White Dent of Virginia is seemingly the best of newer varieties.

Tests were made of hybrids on four experiment fields, in comparison with Pride of Saline and Reid's Yellow Dent. The hybrid seed gave an average increase in yield of approximately 20 percent, and it appears that the percentage of increase was about the same at all levels of productivity. On the Experiment Station farm at Lexington, the best hybrids showed little superiority over other sorts where the usual number of plants were grown. However, more hybrid plants may be grown, per acre, as they are smaller.

About 50 bushels of Double 69 were produced by a commercial grower. Top crosses of inbred strains produced high yields.

*Hill vs. Broadcast Fertilization of Corn.* It is recognized that on land not previously fertilized, and when a moderate amount of fertilizer is used, hill application is more effective than broadcast application. It was questioned whether this holds true if a sufficient quantity of fertilizer for the grain and hay crops were used, and if manure were returned to the corn ground in amounts possible under practical live-stock management. In 1929, experiments to answer this question were begun at Campbellsville and Princeton. Fertilizer was applied broadcast on one-half of each plot, at Campbellsville, where corn was planted, and part broadcast and part in the hill on the other half. The amount put into the hill was equivalent to approximately 200 pounds of 4-8-4 fertilizer where a complete fertilizer was used. The partial mixtures furnished the same amounts of the elements as in the complete mixture. Up to 1933 at Campbellsville and 1934 at Princeton, fertilizer was put in the hill in a strip about 10 to 12 inches long, and thoroly mixed with the soil. No significant advantage was found for hill fertilization at either place. It was feared, however, that there might have been some injury from the fertilizer applied in the hill this way. In 1934

and 1935, at Campbellsville, the fertilizer was placed in bands on each side of the hill and a little below the level of the seed, and again no significant difference was found. In 1935 the same method of application was used at Princeton, with similar results.

At Campbellsville there were 10 comparisons each year, and at Princeton 16. The largest gain for hill fertilization was at Princeton in 1934, amounting to 3.9 bushels an acre. When nitrate of soda was used, it was used on the plot where phosphate and potash were applied broadcast. The tests included the following treatments: P, PK, PN, PKN.

*Bluegrass for Pasture and Seed Production.* Studies show that Kentucky bluegrass is largely, perhaps wholly, self-fertilized and that strains differ in seed and herbage yields, and in vigor. Legume-free bluegrass plots were weedy, the grass was yellowish and made little growth, and the sod was thin. Legume-bluegrass plots were almost weed free, grass dark green and vigorous, and the sod heavy. For the second time, Korean lespedeza sown in a heavy bluegrass sod and allowed to make full growth before harvesting, killed the bluegrass in spots and produced thin sod, but where the mixture was cut frequently to imitate pasturing, no harm was done. Bluegrass is not benefited so quickly by lepedeza as by other legumes, it appears, but the final effect seems to be similar.

*Rye Pasture versus Bluegrass Pasture for Ewes with Lamb.* The experiment of last year (47th Annual Report, p. 42) was repeated with the same ewes, except that one had died in the meantime. The ewes were bred in August, 1934 and put on pasture December 21. The ewes on rye pasture average 108.6 pounds in weight, and those on bluegrass, 104.1 The former consumed 230 pounds of clover hay per head, during the experiment, and the latter, 229 pounds. The 19 lambs dropped by the 15 ewes on rye pasture averaged 9.26 pounds weight at birth; the 20 lambs dropped by the 16 ewes on bluegrass averaged 8.25 pounds. As before, there was a difference of a pound in favor of the rye pasture.

*Roughages for Bred Ewes.* Three groups, each composed of 1 crossbred, 3 Southdowns, 3 Hampshires, and 3 Cheviots, were

fed No. 1 grades of alfalfa hay, Korean lespedeza hay, and lespedeza sericea hay, respectively, in a shed with access to an open, concrete-paved pen. The ewes did not relish lespedeza sericea hay; therefore their feed was changed to Korean lespedeza hay at the end of 28 days. The following is a summary up to that time:

| Kind of hay fed | Average wt. per head Jan. 1 lbs. | Gain per head in 28 days lbs. | Hay consumed per head lbs. |
|---|---|---|---|
| Alfalfa | 114 | 8.1 | 96 |
| Korean lespedeza | 112 | 4.9 | 78 |
| Lespedeza sericea | 114 | -9.9 | 43 |

The ewes fed on lespedeza sericea hay lost nearly 10 pounds per head, in 4 weeks.

The third group of ewes received Korean lespedeza hay for 15 days, after which they received clover hay until the end of the test. They recovered the lost weight. The experiment may be summarized as follows:

| Kind of hay fed | Number of lambs | Wt. of lambs at birth per head lbs. | Final wt. of ewes per head lbs. | Hay consumed per head lbs. |
|---|---|---|---|---|
| Alfalfa | 11 | 7.8 | 98 | 587 |
| Korean lespedeza | 5 | 7.1 | 93 | 445 |
| Lespedeza sericea, 43 lbs.; Korean, 50 lbs.; clover, 388 lbs. | 10 | 6.3 | 108 | 481 |

The one barren ewe in the first lot gained 5 pounds during the test; the five in the second lost 3 pounds per head, and the one in the third lot lost 20 pounds in the first 28 days, but had gained 14 pounds over her original weight, at the end of the test.

*Cost of Producing Lambs.* This study included 110 flocks located as follows: Inner Bluegrass region, 40 flocks; Washington County, 23 flocks; Owen County, 31 flocks; Meade County, 16 flocks. The analysis of the records indicated the following as having a significant influence on profits in lamb production:

1. Culling and replacing so that a large part of the flock will

be ewes ranging from 2 to 5 years of age. 2. Drenching the ewes regularly. 3. Having available early small grain pasture and later pastures containing legumes. 4. Selling a large proportion of the lambs by the first of August.

*Cost of Producing Pork.* This study showed the unit requirements, costs, returns, and management practices influencing profits. Forty-five herds of hogs were studied, 30 of which were in Union County, and 15 in the Inner Bluegrass region. Results showed that the following practices have significant influence in lowering production costs and increasing profits: 1. Raising a large percentage of pigs farrowed. 2. Having a fairly large hog enterprise. 3. Full feeding the pigs from start to marketable weight. 4. Producing in accordance with market demands.

*Pasture for Hogs.* To determine the feeding value of several kinds of pasture, three lots of 18 pigs each, having an average weight of 42 pounds, were grazed on separate pastures of oats and rape, bluegrass, and alfalfa, and were fed 3 percent of their live weight in shelled corn. The pigs on oats and rape gained .81 pound, daily; those on bluegrass, .60 pound; and those on alfalfa, 1.05 pounds. The corn required for 100 pounds gain was 318.8 pounds, 428.5 and 259.7, respectively, for the three lots.

For a second test, 9 pigs from each of the three lots were put into a new alfalfa field, and at the same time 9 pigs from each of the three lots were put on a Korean lespedeza field. The 27 pigs on alfalfa gained .85 pound each, daily, and had 288.4 pounds of corn for every 100 pounds gain. The 9 pigs transferred from the first alfalfa pasture gained .97 pound daily, the 8 from bluegrass (1 died the first week) gained .66 pound, and the 9 from oats and rape, .92 pound.

The 27 pigs on lespedeza gained .59 pound each daily, and had 373.2 pounds of corn for 100 pounds gain. The 9 from the alfalfa pasture made an average daily gain of .63 pound; those from bluegrass .579 pound; and those from oats and rape, .577 pound.

*Distillery Slop for Hogs.* Two trials were conducted to ascertain the value of different forms of distillery slop as feed for

hogs. The forms were "thin," "settled," "whole," and "evaporated." Three lots of 10 hogs each, averaging 100 pounds in weight, were used in the first test. The hogs fed thin distillery slop alone lost 58 pounds in five weeks. They then were changed to settled slop, corn and tankage, 50 pounds of corn being fed for every barrel of thin slop. On this feed the total gain was 490 pounds, in five weeks. Continued on this combination another five weeks, the hogs made an additional gain of 425 pounds. At the end of 15 weeks, they were eating 25 pounds of settled slop, 4 pounds of corn and 4/10 pound of tankage, and their average weight was 188.5 pounds.

Lot 2, fed on settled slop alone, made a net gain of 302 pounds, tho they lost weight the first five weeks. Lot 3 had settled slop and corn, and gain 150 pounds the first five weeks, 216 pounds the second five. During the last week of the second period, the hogs went off feed, so tankage at the rate of 1/10 the weight of corn, was added to their ration. With this change the hogs made more rapid gains, and their gain for this period was 507 pounds.

The tests indicate that the slop should be settled and the supernatant liquid skimmed off, and that the thicker portion should be supplemented with tankage, to improve the quality of protein and with corn to furnish additional carbohydrate.

The second test was to determine the value of different forms of slop when fed with corn and tankage self-fed. Nine hogs were used in each lot for the 49 days of the tests.

Lot 1, fed corn and tankage, made a daily gain of 1.81 pounds a hog, requiring 371.9 pounds of corn and 42.1 pounds of tankage for every 100 pounds of gain. Lot 2, fed all the whole distillery slop they would consume, supplemented with corn and tankage, made an average daily gain per hog of 2.05 pounds, requiring 309.6 pounds of corn, 30.4 pounds of tankage and 738.4 pounds of whole slop for each 100 pounds of gain. Compared with Lot 1, 739.4 pounds of whole slop saved 62.2 pounds of corn and 11.7 pounds of tankage for each 100 pounds of gain in Lot 2. Lot 3, fed settled slop with corn and tankage gained 1.89 pounds daily. In comparison with Lot 1, 835.6 pounds of settled slop saved 50.2 pounds of corn

and 8.5 pounds of tankage for 100 pounds of gain made by the hogs in Lot 3.

Lot 4 made a daily gain of 2.08 pounds per hog on evaporated slop, corn and tankage. Compared with Lot 1, the 755.4 pounds of evaporated slop fed Lot 4 for each 100 pounds of gain were equivalent to 108.8 pounds of corn and 28.9 pounds of tankage.

Lot 5 gained 1.69 pounds on evaporated slop only. For a gain of 100 pounds in weight in comparison with Lot 1, 2,114 pounds of evaporated slop were equivalent to 371.9 pounds of corn and 42.1 pounds of tankage.

As carcasses of the hogs varied in softness, 16 were sent to a government inspected packing house for grading. Two carcasses from Lot 1 were hard; of the 4 sent from Lot 2, 3 graded medium hard and one soft; of the 2 carcasses from Lot 3, one was hard and one medium hard; in Lot 4 one carcass was hard, one medium soft and one soft; in Lot 5, 3 were oily and 2 soft.

*Steer Feeding.* A trial to determine the feeding values of No. 1 Korean and lespedeza sericea hay was begun February 21 and continued to April 4, using two lots of 10 yearling Hereford steers each. Steers in Lot 1 were fed 5,700 pounds of Korean lespedeza, of which they refused 285 pounds. They consumed also 2,150 pounds of corn and 25 pounds of salt, and made an average gain of 53 pounds. Steers in Lot 2 were fed 5,720 pounds of lespedeza sericea hay, of which they refused 2,172 pounds. They ate also 2,150 pounds of corn and 20 pounds of salt, and lost 11 pounds a head.

After the test, the steers were continued on the same feeds, except that the hay was finely ground. Steers in Lot 1 ate all the ground Korean lespedeza hay, but those in Lot 2 left an increasingly large percentage of lespedeza sericea hay even tho molasses was added. When both lots were put on Korean lespedeza hay, those in the first lot gained 1.5 pounds a head daily and those in the second lost 2.17 pounds. From April 20 to May 12, the steers in both lots were fed an inferior grade of loose alfalfa. Lot 1 made a daily gain of 1.43 pounds and Lot 2, 1.93 pounds. Put on bluegrass pasture from May 13 to

October 19, and given 7 pounds of ground corn each, daily, steers in Lot 1 gained 2.26 pounds each daily, and those in Lot 2, 2.25 pounds.

*Cost of Producing Beef.* Studies in the cost of producing beef were carried on with 20 herds in Union County and in the Inner Bluegrass region. Practices which generally proved profitable for the producers of fat calves were: (1) feeding grain to nursing calves, (2) marketing fat calves in fall or early winter, and (3) maintaining a cow herd ranging from 2 to 9 years old.

*Turkeys.* Some of the effects of age of breeding stock and crossbreeding in the turkey are being studied. Calculating dressing percentage as the ratio of the weight of dressed carcass to the live weight, White Hollands dressed 74.8 percent; Bronze, 76.6, and crossbreds, 76.3. Young birds weighing 15 pounds and more dressed 76 percent; those 10 to 14¾ pounds, 76.9, and those under 10 pounds 75.6 percent.

Incubation experiments indicate three distinct embryo growth phases with a direct relationship between embryo temperature and growth. From these studies it is concluded that incubation practices which tend to increase hatchability in chicken eggs should be applicable with similar favorable results to turkey eggs.

*Vitamin D and Embryo Development.* The calcium and phosphorus content of the embryos of eggs from hens confined without sunshine or a vitamin D supplement was much less than that of the embryos from the pens where the hens received sunshine or cod liver oil. The greatest difference occurred during the period of greatest embryo mortality, the 18th and 19th days.

*Lipoid Phosphorus of Egg Yolk.* Investigations were carried on to find out whether the nutritive value of eggs to human beings can be increased or changed by giving the hen treatment that is recognized as improving calcium and phosphorus metabolism, namely, sunshine, bluegrass or cod liver oil or combinations of the three.

Analyses, in duplicate, of 205 fresh eggs and 144 storage eggs showed that the percentage of lipoid phosphorus was

practically the same in eggs that had been stored from nine to twelve months as in fresh eggs. The quantity per whole yolk, however, was larger in stored than in fresh eggs. In all cases, when cod liver oil was added to the hen ration, the lipoid phosphorus content of the egg yolk was decreased as compared with eggs produced by hens that did not receive cod liver oil.

*Iron and Copper Content of Egg Yolk.* An experiment was conducted with 10 pens of hens, under different conditions, to determine whether a copper or iron compound, added in small quantity to the feed, would affect the quantity of these substances in the egg yolk, or the condition of the liver, spleen or kidneys. Some hens were given copper or iron, or both, in their feed, at the rate of 0.5 or 0.6 mg. of the former and 25 mg. of the latter per 100 grams of feed; others were given these substances in their drinking water. The copper content of the yolk was least when both iron and copper were fed. Copper alone increased the iron content but decreased the copper content of the yolk.

Feeding copper did not seem to affect the percentage of copper in the liver, spleen or kidneys, except when stearin was fed. Feeding iron increased the percentage of iron in these organs. Iron and copper together had less effect than either alone.

*Paratyphoid Bacilli.* Continued work on the *Salmonellas* revealed that a serologic variant of *S. aertrycke* is sometimes the etiologic agent in paratyphoid infection of pigeons. Cultures isolated in Kentucky and cultures received from Connecticut and New Jersey belonged to this type. The variant possesses flocculating antigens typical of *S. aertrycke* but the somatic antigen is identical with that of *S. abortivo-equinus.* The cultures vary in their action on maltose, some fermenting the substance readily while others do not attack it. The designation *S. aertrycke* var. *storrs* was proposed for the variant.

*Salmonella aertrycke* is widely distributed and often encountered in infections of man and animals, so that any method of dividing this species into sub-types would be welcome. Examination of 37 cultures derived from 7 outbreaks of animal disease demonstrated that they could be divided into 4 groups

by their rate of fermentation of certain sugars. Maltose and xylose, as well as rhamnose, were used in the peptone-salt medium of Bitter, Weigmann and Habs. The tests were conducted in the same manner as the Bitter test. The 4 groups established by this method were well defined, and all strains isolated from any one outbreak of disease belonged to the same group. This fact may be of considerable value in epidemiological and epizoological studies.

Study of cultures of *S. aertrycke* var *binns* has demonstrated that these organisms are not permanently and totally nonspecific, but that they possess a specific phase characteristic of *S. aertrycke*. The number of specific colonies found in different cultures of this type varies widely. Transplants from different laboratories, all derived from the same parent culture, also differ widely in the amount of specific antigen they possess.

The somatic antigens of the Binns type resemble those of *S. abortivo-equinus* rather than those of *S. aertrycke*. Thus the specific races isolated from Binns cultures are serologically identical with the variant, *S. aertrycke.* var *storrs,* isolated from pigeons.

*Animal Parasites.* Port-mortem examinations of domestic animals during the past three years revealed that parasitisms often are the cause of losses and of general unthriftiness in whole flocks and herds. A few instances of parasitism not generally recognized as having an important bearing on animal health were observed. Several instances of inflammation of the crop and proventriculus in turkeys were found. The walls of the organs affected were thickened and the mucosa was covered with a well-organized pseudomembrane. A large number of small parasites were found beneath this false membrane. The eggs of this parasite were lemon-shaped, which denoted that they were of the species of capillaria. *Dispharynx spiralis* causes proventriculitis in birds but capillaria has not been reported from the proventriculus. *Dictyocaulus viviparus,* a lung worm of cattle, was found in several herds of cattle, and *Dictyocaulus filaria,* a lung worm of sheep, was found in a few flocks of sheep. The larva of the primary

screw worm fly, *Cochliomyia americana,* was definitely identified for the first time in this state. This screw worm is common in the southwest but was thought not to occur this far north. However, fly larvae have been found in wounds of domestic animals in Kentucky for years. Further work on parasitisms of horses brought to light that parasites are often the primary cause of unthriftiness, sickness, and death. Autopsies on horses showed that the following kinds of parasites are frequently present, often in large number; bots, stomach worms, *(Habronema spp.),* ascarids, strongyles, and other closely related genera and species. The strongyles and related species (Palisade worms) are found in their adult stage in the large intestines. They produce a severe chronic inflammation and abscess formation in the intestinal wall. In all young horses extensive active verminous aneurysms, due to *Strongylus vulgaris,* were found in the mesenteric arteries. The number of parasites found in the digestive tract of horses and the lesions produced by them reveal the prevalence of parasitisms of the horse and particularly in the young animal from birth to maturity. Examination of over 900 samples of horse feces showed that a majority of the samples were teeming with parasite eggs. Feces from horses raised under a system of parasite prevention showed fewer eggs than were found in feces from horses raised where no preventive measures were practiced. Examination of feces for parasite eggs after the animals had been treated for the removal of intestinal parasites showed that the egg count could be reduced 75 to 100 percent. However, treatment for the removal of intestinal parasites is of a temporary nature, as reinfestation soon occurs. Treatment for the removal of parasites of the digestive tract has little or no effect upon lesions caused by parasites in the organs and tissues outside the alimentary tract.

*Delayed Conception and Sterility in Dairy Heifers.* In connection with this study, 997 samples of urine from 113 cows and heifers have been examined, since October, 1930. Of these 113 animals, 80 did not show albumin in the urine at any time; 23 showed albumin at irregular intervals, and 10 showed albumin in the urine on each examination. As a check on this

work, samples from 40 animals in two other herds were examined, not one of which showed albumin.

The significance of albumin in the urine of dairy heifers and cows is not altogether clear. Albumin is expected in the urine of certain sick animals but not in that of normal animals. The 10 animals that regularly had albumin in the urine were not always visibly sick when albumin was present, but their record shows that they were sick more frequently than the average animal in the herd.

From 1894 to 1930 the cows in this herd produced an average of four calves each. The 10 cows that consistently showed albumin in the urine were pregnant twenty times and produced 16 live calves. Three cows aborted once each and one cow died during pregnancy. Eight of the 10 were removed from the herd; five are dead, three of which showed upon autopsy chronic interstitial nephritis and streptococci were isolated from the kidneys, no autopsy was held on the two others. Three will be killed later and a post-mortem examination will be made. The two cows remaining in the herd have become sterile; of these one has produced five live calves, which is 31 percent of the total live calves produced by the ten cows; the other cow has produced only one calf, and has been sick for two months.

*Phosphate Fertilizers on Lima Beans.* Season after season the yield of large-seeded lima beans has been a failure on the rich bluegrass soil of the Experiment Station farm. Reports of similar experiences have been received from the Bluegrass section of the state. It was noted that the phosphorus content of bean plants tended to be low in comparison with the amount of nitrogen, despite the high phosphorus content of the soil. To determine if the phosphorus content of the plants could be increased by phosphate fertilizers so as to obtain a more favorable ratio between nitrogen and phosphorus for fruit development, a field of beans was divided into two parts, to one of which 20 percent superphosphate was applied at the rate of one ton per acre. The fertilizer was applied in a concentrated continuous band 4 to 6 inches from the row and about 3 inches deep. Care was taken to avoid mixing the fertilizer with the soil in order to reduce fixation by the soil.

The ratio of nitrogen to phosphorus in the bean plants was reduced from 9 in the controls to 6 in the fertilized plants. The yield of the treated plot was 61 percent greater than that of the check. At prices prevailing during the past season the income of the treated plot exceeded that of the check by $36. The significant point seems to be that the lima bean is unable to obtain a sufficient amount of posphorus from the fixed phosphorus of the soil to balance the continued uptake of nitrogen which these soils supply.

It is clearly demonstrated in this test that the use of superphosphate fertilizer tends to correct the unfavorable nitrogen phosphorus relationship and promotes the fruitfulness of the lima bean.

*Cultivation of Lima Beans.* It is not uncommon to find lima beans which make a strong vine growth and a poor yield. This tendency is increased by wet weather such as was experienced in the spring and early summer of 1935. Tests for nitrogen and phosphorus made on the conducting tissues of such plants showed that phosphorus was low compared with the nitrogen present, despite the high phosphorus content of the soil. The solution to the difficulty seems to require either a reduction of the nitrogen supply or an increase in the supply of phosphorus. An attempt was made to control the nitrogen supply by changing the method of cultivation. A patch of lima beans was divided into plots to receive different types of cultivation. Frequent deep cultivation increased the nitrogen supply and reduced the crop. Shallow cultivation, barely sufficient to prevent the surface soil from baking, resulted in a sharp decrease in the amount of available nitrogen and a favorable balance between nitrogen and phosphorus, which produced an increase in yield ranging from 30 to 35 percent. The soil in the plots that were not cultivated but on which the weeds were kept down by scraping became very hard, and the nitrogen content in the plants was reduced to a point that resulted in small vines and a low yield. The yields in this plot were good at first but soon diminshed.

A study of the N/P ratios at the beginning of the fruit-setting period of lima beans showed the following:

Continuous deep cultivation—a ratio of 9.

Early deep, followed by shallow cultivation—a ratio of 7.5.

Continuous shallow cultivation—a ratio of 6.2.

No cultivation, weeds removed by scraping—a ratio of 3.5.

This seems to indicate that modification of cultivation practice may be a cheap and practical means of repressing excessive nitrogen accumulation in the plants at critical periods when fruit is being set, and of increasing the nitrogen again when it is needed to mature the crop.

Good cultivation practice based on the results obtained this year on a heavy soil indicates that early cultivation should be deep and frequent enough to cause the release of nitrogen and good growth. As the fruit setting period approaches, cultivation should be regulated to prevent excessive growth when the weather is favorable to rapid growth, by using less frequent, shallow cultivation. After the crop is set a renewed release of nitrogen may be necessary for fruit development and this may be regulated by the depth and frequency of cultivation. Of course, undue cutting of roots must be avoided as the season progresses.

Release of nitrogen probably would not be influenced greatly by variation of cultivation on loose soil that does not bake.

*Nutrition of the Tomato in a Drying Soil.* A study was made of the nitrogen, phosphorus and potassium content of tomato tissue from plants that were growing in a soil that was slowly drying during a drouth. The amount of soluble nitrogen in the tissues increased as the soil dried, the amount of phosphorus was reduced as the moisture in the soil became limited, and there was little change in potassium content until near the wilting point, when the amount was slightly increased. It appears that at least part of the stunting effect of drouth may be due to reduced availability of phosphorus in dry soil.

*Tomato Variety Test.* The Prairiana, a new variety, was outstanding in the test this year. The yield for both the spring and fall crops was more than 30 percent larger than from any other variety. This result seems to warrant its recommendation for trial to growers for home and market. Pritchard, Marglobe, Bonny Best and Stone maintained their high standing among the older varieties tested.

*The Effect of Nitrogen on Potatoes.* The effect of nitrogen

fertilizers was strikingly different on the spring crop and on the fall crop, in 1935. On the spring crop, with favorable conditions of moisture and temperature, nitrogen fertilizers were decidedly beneficial. In the fall crop, the drouth and high temperatures nullified the benefit of nitrogen fertilizer. The sources of nitrogen used for comparison were nitrate of soda and sulfate of ammonia, alone and in combination, and barnyard manure at 10 tons per acre and at 40 tons per acre. Eight tons of straw were used to reduce the nitrogen supply.

The nitrate of soda and sulfate of ammonia were applied as side dressings. Comparison was made between one application when the plants were 4 to 8 inches tall and 5 applications during the growing season. The manure and straw were applied before planting time.

The yield of the spring crop was increased by all additions of nitrogen fertilizer. Applications at the beginning of the season were more effective than applications made at intervals during the growing season. The accelerated vine growth and the nutritive conditions were favorable at the time tubers were forming. Application of 200 pounds of nitrate of soda and 300 pounds of sulfate of ammonia, per acre, when the plants were 4 inches tall, produced the best yield, 279 bushels per acre. This was decidedly better than any other treatment. Nitrate of soda alone was more effective than sulfate of ammonia alone. Ten tons of barnyard manure per acre was as effective as 40 tons. The straw reduced the nitrogen supply and the yield.

No significant benefit was found from the use of nitrogen fertilizers on the fall crop. Nitrate of soda applied at one time, when the vines were 6 to 8 inches tall, produced a small increase in yield, as did also the application of manure. The continuous applications of nitrogen were detrimental. The initial stimulus from the use of nitrogen fertilizer produced a large vine and a large leaf area which increased the water requirement at a time when soil moisture was diminishing. High temperature at this time further increased the requirement for water. The manured plots seemed to hold soil moisture during the drouth better than the others, and the slight-

ly better yield on these plots may have been due to the application of manure.

Plant tests were begun to determine the interrelationship between nitrogen and phosphorus that promotes tuberization. The data obtained seem to indicate that formation of tubers was influenced by a balance between nitrogen and phosphorus, but further work will be required to establish the optimum ratio.

*Time to Plant Potatoes.* The test to determine the best date to plant second-crop potatoes showed again that plantings made between July 10 and 20 produced larger yields than those made earlier or later. During the past 5 years the yields of the plantings in mid-July total considerably larger than plantings made at other dates.

*Potato Variety and Strain Test.* Spaulding Rose, Warba, Early Ohio, Triumph and four strains of Irish Cobbler were tested. Spaulding Rose was the outstanding variety in the test this year. The yield was about 40 percent larger than that of the best strains of Cobbler, and the percentage of marketable tubers was high. Triumph produced about 20 percent and Early Ohio 40 percent less than Cobbler. Considering yield, earliness, size and quality of tubers, the Cobblers were second only to the Spaulding Rose. It is possible that the past season was especially favorable to the Spaulding Rose. It will be tested further.

*The Effect of Freezing Sweetpotato Vines on the Keeping Quality of the Tubers.* A patch of sweetpotatoes was divided into two parts. On one, the vines were cut immediately after being frosted and on the other the frosted vines were allowed to remain intact until the patch was dug about two weeks later. The potatoes were cured immediately after harvest at a temperature of about 75 degrees Fahrenheit. Two months after harvest no rot had appeared. It appears that failure to cut the frosted vines this year was of no consequence. The very dry soil condition during the fall may have contributed to this favorable result.

*Spraying Tests on Red Raspberries.* The sharp contrast between the sprayed and unsprayed plots at the Princeton Substation was not found at Lexington. There was no convincing

evidence that a delayed dormant spray with Bordeaux mixture for the control of anthracnose had any effect on the yield, and the use of lime sulfur was injurious to the foliage. The use of three or more summer sprays of Bordeaux mixture for the control of leaf spot was accompanied by an increase in yield in most cases. The results of work to determine the timing of summer sprays were inconclusive.

*Black Raspberry Tests.* The question of the quality of plants from weak canes was raised in the spring of 1933 when it was found that weak mother canes had died during the winter. Tip plants from these dead canes were planted beside tip plants from healthy mother canes. In 1935, these plants produced a good crop. No significant difference could be noted in the character of growth or in the yield of the two lots.

*Cover Crop Test in a Young Apple Orchard.* This test has been in progress for six years. The cover crops are lespedeza sod, sweet clover and soybeans, bluegrass sod, and millet and barley. The gain in the trunk circumference of the trees seems to give a fair index of rate of growth induced by the different treatments. The average gain in trunk circumference during the past two years is as follows:

| | |
|---|---|
| Millet and barley | 2.44 inches |
| Lespedeza sod | 2.21 " |
| Sweet clover, soybeans | 1.79 " |
| Bluegrass sod | 1.76 " |

The chlorophyll content of the foliage was found to be proportional to the amount of growth. The leaves from trees on the millet and barley plot contained about 40 percent more chlorophyll than those of the trees on the bluegrass plot. The fruit crop was too light to make the comparisons of yield between plots significant.

*Soluble Nitrogen and Phosphate Phosphorus Content of Apple and Peach Wood.* From March 22 to December 17, 1935, weekly analyses were made of peach and apple wood, for soluble nitrogen and phosphate phosphorus. Terminal twig tissue was used thruout. An extract from the woody tissue was prepared by grinding in a mortar, with sharp sand, one gram of twig tissue cut into fine pieces, and 10 cc. of 2 percent acetic acid. About a half teaspoonful of phosphate-free charcoal was

added as a clearing agent, and the solution was filtered. Aliquots of the extract thus obtained were used for the determination of soluble nitrogen and phosphate phosphorus by the method described by Emmert. The following table shows the range of soluble nitrogen and phosphate phosphorus content of the tissue of apple and peach trees:

**Soluble Nitrogen and Phosphate Phosphorus in Apple Twigs**

| Cover Crop | Average of Soluble Nitrogen ppm. | | | Average of Phosphate Phosphorus ppm. | | |
|---|---|---|---|---|---|---|
| | Mar. 22 to June 1 | June 1 to Aug. 1 | Aug. 1 to Oct. 1 | Mar. 22 to June 1 | June 1 to Aug. 1 | Aug. 1 to Oct. 1 |
| Lespedeza | 340 | 308 | 171 | 161 | 117 | 125 |
| Millet and Barley | 457 | 220 | 230 | 160 | 103 | 148 |
| Bluegrass | 206 | 108 | 152 | 130 | 104 | 200 |
| Sweet Clover and Soybeans | 383 | 248 | 258 | 124 | 124 | 157 |

All the apple wood analyzed was of the Winesap variety. In general the content of nitrogen in the apple tissues was high in the spring just before growth started and gradually declined during the period of active growth. During the latter part of the summer there was a gradual increase until leaf fall, when the amount of nitrogen fell to a low point. Following rains, the nitrogen content of the tissues increased, and was lower during dry periods. The phosphate phosphorus content seemed to vary inversely with the soluble nitrogen content indicating that as the nitrogen increased, the phosphorus was being utilized by the tree.

The level of nitrogen content of the apple trees in the millet and barley plot was consistently higher thruout the season than that of the trees in the other plots, but the highest amount of soluble nitrogen at any time was found in the trees from the lespedeza plot about the middle of May and from the sweet clover plot in April.

The analyses of peach tissue were made from trees of the Elberta variety. The soluble nitrogen and phosphate phosphorus were followed in trees that had received various treat-

ments with nitrogen fertilizers. Peach tissue contained much higher amounts of these nutrients than apple tissue.

In general the level of nitrogen content of peach tissue was high just before growth started in the spring and gradually declined until about August 1, then there was a marked increase until October 1. After leaf fall, the nitrogen content remained practically constant.

The range of high and low content of soluble nitrogen and phosphate phosphorus of peach trees with different fertilizer treatments is shown in the following table:

**Soluble Nitrogen and Phosphate Phosphorus in Elberta Peach Twigs**

| Fertilizer Treatment | Averages of Soluble Nitrogen ppm. | | | Averages of Phosphate Phosphorus ppm. | | |
|---|---|---|---|---|---|---|
| | Mar. 22 to June 1 | June 1 to Aug. 1 | Aug. 1 to Oct. 1 | Mar. 22 to June 1 | June 1 to Aug. 1 | Aug 1 to Oct. 1 |
| Nitrate of soda 4 lbs. per tree March 25 | 245 | 528 | 962 | 229 | 174 | 197 |
| Nitrate of soda 2 lbs. March 25. 2 lbs. June 1 per tree. | 242 | 488 | 704 | 245 | 231 | 305 |
| No fertilizer | 214 | 455 | 828 | 232 | 277 | 309 |
| Nitrate of soda 4 lbs. per tree June 1 | 243 | 728 | 1026 | 219 | 233 | 227 |
| Calcium cyanamid 2 lbs. per tree March 9 | 258 | 453 | 763 | 202 | 259 | 269 |

Nitrogen content increased materially following the application of nitrogen fertilizer. This increase was noticeable within a week after the application and the level continued high thruout the remainder of the season.

After leaf fall the nitrogen content of apple tissue fell rapidly to a level of about 100 ppm while that of peaches maintained levels ranging from 600 to 1000 ppm. During this pe-

riod the phosphorus content of both apple and peach was fairly constant, ranging from about 100 to 150 ppm.

It is possible that the difference in the nitrogen content of dormant tissue of apple and peach may be an index of their relative hardiness. Recently, some analyses have been made on hardy and tender varieties of peaches. The tender varieties were found to contain more nitrogen in dormant tissue than the hardy varieties.

In further work on peaches growing in soil that was low in phosphorus content, it was found that applications of nitrogen reduced the phosphorus content of the twigs to a low point as compared with the trees grown on the high phosphorus soil at the Experiment Station, which showed less reduction in the phosphorus content following the use of nitrogen fertilizer. These results suggest that the nitrogen-phosphorus relationship in peaches, and perhaps other fruits, may be very important.

*White Pine Blister Rust.* The Experiment Station and the Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture are cooperating in a survey of the State to ascertain the situation relative to the disease and its two hosts. The survey is nearly completed and no white pine blister rust has been found.

*New Spray Mixtures.* Tests showed that the addition of aluminum sulfate and half its weight of hydrated lime to lead arsenate sprays reduced arsenical burn. Larger dosages of the combination have been used each year for three years. As the amount was increased, the deposit of arsenic was increased and more uniformly spread over the surface of fruit and leaves. In the period of one month arsenical deposit was increased 18 percent and weathering decreased from 65 to 50 percent. The combination increased the bulk of spray when freshly made. Thus 2 parts of lime and 4 parts of aluminum sulfate made over 400 parts of colloidal mass, measured at the end of 24 hours. When this combination was added to peach sprays, lead arsenate dosage was increased from 2½ to 4 pounds per 100 gallons.

Aluminum sulfate and lime combined with soybean flour

made a good emulsifier for mineral oil when the method of tank mixing was used.

An improved method of using fish oil and linseed oil in sprays was evolved whereby the oils are combined with the lead arsenate before adding them to the Bordeaux mixture, or lime-sulfur solution.

It was noted that there was little or no change in water-soluble arsenic when 1/3 or ½ pound tar soap and 3 or 4 pounds of lead arsenate are used in 100 gallons of spray. If more than that dosage of tar soap is used, the amount of water-soluble arsenic is increased considerably.

In experiments on bean plants, pine tar oil was shown to be a buffer for small amounts of water-soluble arsenic.

In an attempt to combine lead arsenate and tar soap, a product resulted which was not easily wetted. Observations later in the field showed lead arsenate-soap combinations or Bordeaux mixture-soap combinations were more resistant to washing by rains than combinations without soap. It will be difficult, therefore, to manufacture a product comparable to the tank-mixed combination since it is not miscible with water after being dried.

Kerosene aids soap materially in flocculating and adding to bulk and coverage of lead arsenate if the mixtures are properly made. In successful mixtures the kerosene was emulsified with soap. The lead arsenate was added to this combination when diluted with about an equal quantity of water. When the kerosene was added as the last element in the spray tank, the arsenical deposit was actually decreased. Unemulsified summer mineral oil was mixed the same way. It added adhesiveness and not flocculation to the lead arsenate. When added last to the spray combinations it increased run-off. Mineral oil, emulsified with ammonium caseinate, increased deposit of spray materials irrespective of method of mixing.

Soybean flour was used as a spreader for nicotine and as a spreader and adhesive for lead arsenate with results that justify further experiments. Soybean flour has about the same spreading effect as some of the soap spreaders. Its emulsifying properties are good.

*Activators for Nicotine Sulfate.* Saponified wood or gum rosin was found to be much more efficient as a spreader for nicotine than saponified plant or animal fats or fatty acids. Rosin spreaders proved more efficient than the new spreaders made from sulfated higher alcohols and allied products, and they compare favorably in price. The preparation of emulsifiers from the spreaders so that they may be used with mineral oil and kerosene is now in progress.

*Nicotine Thiocyanate as an Insecticide.* Further work on nicotine thiocyanate was done with a view of increasing the efficiency and reducing risk of burning. Triethanolamine soaps gave the best results. Arbor vitae was sprayed under practical conditions, seemingly without injury. Frequent sprayings of excessive concentration caused only a slight chlorosis noticeable on close inspection. Eighty-three different tests were made on red spider, the percentage of kill being determined by microscopic count. The most effective spray consisted of nicotine thiocyanate 1 to 2000, resin 1 to 2000 and triethanolamine (with 1/10 its weight oleic acid) 1 to 5000.

*A Study of New Carriers and Diluents for Nicotine.* Soybean flour, as a spreader, is about as efficient as soap spreaders. Its cost is half that of soap. Kentucky River bentonite was used last year and in some ways it was superior to commercial samples. Its emulsifying action as well as spreading and wetting efficiency are high.

*White Grubs and Their Injury to Farm Crops.* In the work with lights in trapping June beetles, it was definitely shown that most efficient lights to attract the beetles are (1) those of greatest intensity or brilliance and (2) those containing the most blue rays. On foggy nights, however, a green light attracted the most beetles. No beetles came to red lights and only three or four to yellow lights during the period of observation.

Improved emulsifiers were made for use with liquid poison for white grubs after it was shown that the most permanent emulsion of carbon disulfide and orthodichlorobenzene was more effective than those that break easily. The orthodichlorobenzene emulsions were more toxic than the carbon disulfide

emulsions but more apt to cause injury to seedling plants. Other materials that showed promise were beta napthol and the dinitro compounds. A method of using them is being studied.

*The Sod Webworm.* Sod webworms were not numerous enough in sod in 1935 to cause noticeable damage. Abundance of rain kept the grass in good growing condition. Cool weather apparently caused emergence of adults to occur a few days later than recorded for the previous year. Adults were collected at lights. Two main flights were observed, the first from June 5 to 22 and the second August 5 to 20. The bluegrass sod webworm was the most numerous species.

Several small plots of sod in which larve were feeding were treated with insecticides, some of which were fairly effective. The following is a summary of results:

Spray of lead arsenate, 8, 10 and 15 pounds to 100 gallons of water, with soap, killed 78, 91 and 95 percent of the larvae, respectively. Spray of pyrethrum, 1 ounce in 4 gallons of water, killed 90 percent. Kerosene emulsion, usual formula, 1 part to 10 parts of water, killed 92 percent. Cuprous cyanide, 2½ pounds to 100 gallons of water, killed 11 percent. Lead arsenate powder dusted on at the rate of ¾ pound to 100 square feet, brushed in and sprinkled, killed 72 percent.

No permanent injury to the grass resulted from the use of the insecticides. The kerosene emulsion spray burned some of the tips of grass blades in one test where spraying was done immediately after the grass was clipped.

*Corn Earworm Control.* In previous work it was found that cutting off the silks of sweet corn after pollination had taken place, was a promising method of control of the earworm. Further tests were made this year, on early, midseason and late plantings of sweet corn, to determine the effectiveness of clipping thruout the season. In the early planting, part of the rows were clipped as soon as it was judged that pollination had taken place. It was found that some silks continued to grow out after being clipped and that eggs, deposited on them, hatched and caused wormy ears. In the midseason, two clippings were made on a part of the rows of the late plantings,

one just after pollination and another about a week later. The results are shown in the table.

| | | | Percent of Wormy Ears | | |
|---|---|---|---|---|---|
| | | | Not Clipped | Clipped Once | Clipped Twice |
| Early Planting, Harvested | 7/27-8/21 | 45 | 15 | 0 | |
| Midseason Planting, " | 8/28-9/ 5 | 35 | 8 | 0 | |
| Late Planting, " | 9/18-10/25 | 95 | 78 | 38 | |

It will be noted that worm infestation varied considerably and reached a point in late September and in October where the unprotected ears were nearly all wormy. A single clipping in July and August reduced the worm injury considerably and the damage to the few ears that had worms was rather slight because the worms were small at harvest time. Clipping twice protected all ears that were treated in this manner in the midseason crop and materially reduced the percentage of wormy ears in the late crop.

These results indicate that clipping is a means of reducing worm damage and, if the technique can be perfected, it may become a practical method of earworm control for the home gardener and perhaps for the commercial grower.

*Public Service Laboratories.* The examinations in the bacteriological laboratory alone exceeded by 53,240 the number made last year. The handling of this increased volume of work was a perplexing problem because of inadequate laboratory facilities and limited staff. Much of the increase in work was the result of the establishment of additional full-time county health departments and of relief projects. No additional funds were provided by the State to cover the added expense such expansion entailed. The bacteriological, serological and microscopical examinations totaled 187,898. These examinations cover practically every phase of public health work, for infectious and contagious diseases such as diphtheria, tuberculosis, typhoid, dysentery, meningitis, venereal diseases, heads for rabies, sanitary examinations of water and milk, food products for sanitary quality or spoilage, etc.

Examinations were also made of 818 food samples and 282 drug samples. Of these food and drug samples, 322 were official food samples and 50 were drug samples submitted by

the Bureau of Foods and Drugs under the Kentucky Food and Drug Act, 1 by the State Board of Pharmacy, 1 by the Board of Barber and Beautician Examiners, 17 for toxicological examination of human organs, 25 of animal organs, 51 miscellaneous products for poison, 80 waters and 3 wines and beers. The Fish and Game Commission submitted 10 samples of water from different sources to ascertain if streams were polluted with distillery waste sufficient to be detrimental to fish life. Samples of water were submitted from municipal, institutional and private water supplies for examination for specific problems, industrial use, and others for examination for cause of iron sediment, identification of type of algae, cause of clogging water meters, change in water, treatment of cistern water to remove the taste of new cement, etc.

Total examinations made by the department in 1935, 189,-403.

*Seed Inspection and Analysis.* The number of samples received for examination was 3,936. Purity tests were made upon 2,622 samples and 3,009 samples were germinated. The distribution of samples tested was as follows:

| | |
|---|---|
| Grasses | 493 |
| Clovers | 2246 |
| Vegetables | 24 |
| Large seed | 387 |
| Collector's samples | 125 |
| Tobacco | 661 |
| No. lbs. cleaned | 434 |
| No. samples tested | 382 |

Two cases were filed in court. In each case the defendant was found guilty and fined.

*Nursery Inspection.* The growing conditions for nursery stock as well as weeds, were ideal during the past season. However, with the excessive rainfall early in the season, weeds gained such a foothold that many nurserymen were not able to eradicate them. Nurseries, therefore, were inspected under adverse conditions. Only three nurserymen's certificates were withheld because of slow compliance with recommendations for sanitary nursery conditions. The many compliances are ex-

cellent indications of the cooperative spirit existing between the nurserymen of the State and the Experiment Station.

A survey for the phony peach was conducted by the Bureau of Entomology and Plant Quarantine, U. S. D. A., assisted by the Kentucky Agricultural Experiment Station. The disease was found on one tree in Union county, two in Graves county, two in Henderson county, one in Bullitt county and one in Webster county.

During the season, 137 regular inspections of growing stock were made. Of these, 91 were of general nursery stock covering 920 acres; 38, of strawberry beds covering 92 acres, and 8, of raspberry patches covering 37 acres. The latter were given two inspections at an interval of 30 days. Examination of sweetpotato beds and bulbs made up the remainder of the inspection service.

In the course of the year 132 resident certificates, 127 nonresident certificates, 35 agents' licenses, 118 dealers' licenses and 19 special certificates were issued.

Two nursery stock dealers were prosecuted for violation of provisions of the Nursery Inspection Act. Each was found guilty and fined.

*Feed Control.* Improvement in the feed business in 1935 over that of 1934 and the years immediately preceding was marked. Not since 1930 has there been such a demand from feeders and manufacturers for information on feeds. Increased consumption of feedstuffs in 1935 over that of 1934 approximated 40,000 tons.

The interest in feedstuffs is widespread as shown by the many requests for diversified information and analyses on so many varieties of materials. Requests for analyses by dealers and consumers have increased. Formerly, only the protein, fat and fiber determinations were wanted; now, requests are received for complete analysis, including water, ash and carbohydrates.

More recently dog foods have come into prominence, and during the last year or two a tremendous trade in this product has developed. In some instances the names of the dog foods are misleading as to their composition, the ingredients incorrectly stated and the claims for the food extravagant. In ad-

dition to statement of contents, such statements as "Government Inspected", "Fit for human food", are often printed on the labels.

A general inspection of dog foods was made. Seventy samples were taken for analysis. The results showed some of the products to be short in net weight, the ingredients not as guaranteed and the water content excessive, ranging from 70 to 85 percent of the product. This reveals that the purchaser of these products pays not only an enoromous amount for the water content but a similar amount in freight on this water on shipments made from California and distant points in the west, New York and like points in the east, and Chicago and like points in the north, where most of these foods are made.

Complete analyses, to determine their nutrient and mineral content, were made of 34 samples of lespedeza hay of different varieties and localities in the state. These samples were systematically collected under the direction of the Department of Agronomy. The results are interesting. The type of soil, its use previous to growing lespedeza, the kind of crop and fertilizer used in growing them, are reflected in the results and caused a wide variation. Of this group of analyses, the lowest and highest results are: Protein, lowest 9.44 percent, highest 18.45; fat, lowest 2.74 percent, highest 5.33 percent; fiber, lowest 22.10 percent, highest 35.00 percent; ash, lowest 3.67 percent, highest 6.73 percent; nitrogen-free extract, lowest 42.54 percent, highest 56.89 percent; silica ($SiO_2$), lowest 0.23 percent, highest 1.06 percent; phosphoric acid ($P_2O_5$), lowest .23 percent, highest .63 percent. It is significant that all the hays from the poorer soils are low in phosphorus and that most of them are low in protein. The hays from the good soils, on the contrary, may be considered as having a protein and phosphorus content sufficient for nutritional needs.

For the year, 1,124 samples have been analyzed both chemically and microscopically, many of them for complete analysis. Of this number 727 were official samples for check analyses against the guaranties of manufacturers. The remaining 397 samples were analyzed for feeders, dealers, and in connection with investigational work of the Experiment Station, Federal and State feed officials and cooperative projects.

In violations of the feed law, the cancellation of registration and withdrawal from sale of the feed found misbranded or adulterated have been very effective, especially with the manufacturers from other states. However, this procedure is not to take the place of prosecution of a violation when justified, as a violation may be the cause of a prosecution and a cancellation also, but used only when it best serves the purpose.

*Fertilizer Control.* Six hundred and fifteen brands of fertilizer were registered, for which 1,877,000 tags were issued. Analyses were made of 779 samples of fertilizer sumbitted by farmers and inspectors.

*Creamery License.* Licenses to buy milk and cream on the basis of butterfat content were issued to 10 creameries, 12 cheese factories, 6 condenseries, 46 milk plants and ice cream manufacturers, 64 independent operators of cream stations, and 1,192 cream stations operated by creameries. These total 1,330, of which 1,271 were renewals and 59 for new buying places in operation since June 30, 1935. Permits in lieu of license to test pending examination, now in force, were issued to 109 operators of the Babcock test; 240 applicants were issued new licenses and 1,067 operators were issued renewal licenses, all of which expire June 30, 1936. Examinations for applicants for license to test were held as follows: Lexington 5, Louisville 4, Bowling Green 4, Owensboro 4, Mayfield 4, Maysville 1, Cincinnati 1, Marion 2, Hopkinsville 1, specials 18; a total of 44. Notification of these examinations was sent to 634 operators; 386 appeared and 356, or 92.2 percent, made passing grades.

The inspections numbered 1,096, which represented 16,536 individual tests. From the findings of these inspections the operators were graded as follows: A, B or C 851; D (probation) 215; E (operators to be called before the examining board) 30. Testing equipment calibrated for accuracy numbered 26,728 pieces, of which 311 pieces were rejected. Twenty-eight 9-gram weights, 9 test scales, 7 centrifuges, 2 platform scales and 4 dividers were condemned and 93 illegal test bottles were confiscated.

All operators placed on probation were furnished a full report showing wherein their work was unsatisfactory and were informed that further inaccurate testing would necessitate

their appearance before the examining board to show cause why their licenses should not be revoked.

The examining board considered the cases of 30 operators because of inaccurate testing and violation of regulations. The licenses of 23 were revoked, 6 were placed on strict probation with provision for revocation of license if future inspections were not satisfactory, and one request for reinstatement was denied. The case of one operator was held for future consideration.

Instruction of operators as to proper methods of testing was stressed. Experienced testers are often found using improper methods. Leaflets covering various phases of testing have been prepared and distributed to all new testers and others interested or in need of them.

The receipts for the year were $12,572.88 and the expenditures $13,521.28, as itemized:

| | |
|---|---|
| Salaries | $7,737.29 |
| Labor | 2,097.07 |
| Postage and stationery | 372.66 |
| Freight and express | 33.57 |
| Sundry and laboratory supplies | 139.76 |
| Travel | 2,124.45 |
| Contingent | 678.14 |
| Tools, machinery, apparatus | 153.34 |
| Furniture and fixtures | 185.00 |
| | $13,521.28 |

## Robinson Substation

The fruit crops at this substation were practically a failure again this year because of the freeze of April 16. The fruit plantings seem to be in excellent condition for a crop next year.

*Sorghum Sirup.* The effect of fertilizer treatments could not be determined, as soil productivity was modified by river flood water and silt deposits. Atlas variety of sorghum produced an excellent quality sirup.

*Starting vs. Laying Rations for Chicks.* Plymouth Rock pullets

grown on a starting mash averaged 158 eggs a hen in the pullet year and the Rhode Island Reds, 160 eggs. In the other group grown on a laying mash, the Plymouth Rock pullets averaged 163 eggs and the Rhode Island Reds, 159 eggs. Since egg production did not differ significantly the results indicate that chicks may be grown on a simple laying ration, assuming that it contains the minerals and vitamins essential for growth.

*Forestry.* The Civilian Conservation Corps contributed approximately 17,000 man days of labor at the Robinson forest. This made possible large undertakings in plantings; removal of dead wood; construction of truck trails, fire breaks and bridges; forest stand improvement, and other work. Rains kept fires in check and only 71 acres were burned, compared with an average since 1925 of 434 acres. This made 1935 one of the best years the tract ever had, and the territory to be protected has been expanded. As the Kentucky Forest Service is planning to establish wardens for both prevention and suppression of fires, the Civilian Conservation Corps will be able to take on other work.

Plantings were made of 16,000 black walnut, 10,000 white pine and 10,000 short-leaf pine trees furnished by the Kentucky Forest Service. Much dead chestnut, oak, beech, pine, maple, etc., was removed. Chestnut removed amounted to 29,320 board feet, and other woods to 24,874. Much of it was used to make posts and poles for fence construction, flooring, barn repairs and other necessities. Approximately 21.4 miles of truck trails were completed and 9.3 miles of firebreaks built. Sixty miles of foot trails were put in order and 4 miles of new trail added. About 16 acres of forest were thinned and cleaned, and it is estimated that at least 500 acres more need this work.

*Meetings.* The facilities of the Substation are increasingly utilized for meetings of various kinds and more meetings were held this year than ever before. Among them were a non-denominational camp for boys and girls, a leaders' conference camp for farm women, camp for 4-H boys and girls, conference of Southern Mountain Workers and conference of recreational workers. The tenth annual Harvest Festival, held September 19 and 20, attracted a large number of persons. It was the general consensus of opinion that the Festival this year reached

a new high point in the quality and number of exhibits and in the interest manifested by the people.

### Western Kentucky Substation

*Lespedeza Hay Yields.* In a test on unfertilized limestone soil Korean lespedeza produced 2,560 pounds of hay; Kobe lespedeza, 2,720 pounds; common lespedeza, 2,730, and lespedeza sericea, 7,360 pounds from two cuttings per acre. In a test on unfertilized sandstone soil, Korean lespedeza produced 1,620 pounds of hay; common lespedeza, 1,440 pounds; Kobe lespedeza, 2,080 pounds, and lespedeza sericea (2 cuttings) 3,630 pounds, per acre. The yields on the sandstone soil treated two years ago with 2,000 pounds of limestone and 500 pounds of 16 percent superphosphate per acre were 3,020 pounds of Korean hay, 2,810 pounds of common lespedeza, 3,250 pounds of Kobe, and 7,020 pounds of sericea (2 cuttings) per acre.

*Effectiveness of Different Phosphates.* This project is a comparison of the effectiveness of superphosphate, basic slag, 100-mesh rock phosphate, and 300-mesh rock phosphate, in a three-year rotation of corn, wheat and mixed grasses and legumes. The following rates were used:

L = 1,000 pounds of fine limestone an acre at the beginning; SP = 600 pounds superphosphate (16 percent) an acre; fRP = 600 pounds 300-mesh rock phosphate an acre; RP = 600 pounds 100-mesh rock phosphate an acre; Bs = basic slag, phosphorus equivalent of 600 pounds of superphosphate ; K = 300 pounds muriate of potash an acre; N = 100 pounds of nitrate of soda an acre around hill for corn and 100 pounds an acre as a top dressing for wheat.

The phosphate and potash are applied broadcast on the corn ground and serve for the rotation, except that on Plots 11 and 12, 100 pounds of phosphate and 15 pounds of muriate of potash an acre are placed in the hill and the remainder is broadcast. Manure was used on the past two corn crops at the uniform rate of 6 tons an acre on all plots, including checks. The experiment was begun in 1930. Corn was a failure that year because of drouth. The acre yields are given in the following table:

| Plot No. | Treatment | Corn, Bus. | | Wheat, Bus. | | Hay, Lbs. | |
|---|---|---|---|---|---|---|---|
| | | Ave. 5 crops | | Ave. 5 crops | | Ave. 5 years (All cuttings) | |
| | | Yield | Increase | Yield | Increase | Yield | Increase |
| 1 | O | 14.8 | . . . | 1.3 | . . . | 1188 | .... |
| 2 | SPKN | 30.7 | 14.9 | 10.6 | 9.3 | 2276 | 1039 |
| 3 | fRPKN | 33.1 | 16.3 | 12.6 | 11.4 | 2912 | 1625 |
| 4 | O | 17.8 | . . . | 1.2 | . . . | 1336 | .... |
| 5 | BsKN | 35.7 | 17.0 | 8.6 | 7.4 | 2992 | 1667 |
| 6 | LSPKN | 38.4 | 18.8 | 10.8 | 9.6 | 3236 | 1921 |
| 7 | O | 20.5 | . . . | 1.2 | . . . | 1304 | .... |
| 8 | LfRPKN | 35.7 | 16.0 | 7.5 | 6.4 | 3712 | 2448 |
| 9 | LRPKN | 34.2 | 15.3 | 6.7 | 5.8 | 3016 | 1792 |
| 10 | O | 18.1 | . . . | 0.8 | . . . | 1184 | .... |
| 11 | LSPKN* | 31.0 | 15.2 | 8.9 | 8.1 | 2448 | 1384 |
| 12 | LfRPKN* | 28.0 | 14.5 | 6.2 | 5.5 | 2304 | 1360 |
| 13 | O | 11.2 | . . . | 0.7 | . . . | 824 | .... |

* Hill applications

*High and Low Protein Rations for Chicks.* Two lots of Leghorn chicks fed high and low protein rations, respectively, were given also all the skim-milk they would drink. The mash for the low-protein ration contained no meat scrap, but meat scrap was added to the starting mash of the high-protein ration. Meat scrap was hopper-fed separately to both lots after the chicks were 3 months old and the skim-milk was then fed only until 10 a. m. The pullets grown on the low-protein ration averaged 186 eggs in their first year while those grown on the high-protein ration averaged 181, indicating that it is not essential to feed potential layers a high-protein ration during the first 3 months of life.

*Gain and Economy of Finishing Cattle in the Barn and on Pasture.* Two lots of nine steers each were used in this test from June 22 to September 6. The lot fed in the barn weighed 996 pounds a head on June 22, and the lot running on pasture 991 pounds. Both lots made the same gain, 2.24 pounds a head, daily. For every 100 pounds gain, the animals in the barn were fed 579 pounds of corn and cob meal, 38 pounds of cottonseed meal and 791 pounds of hay, costing $13.67. The steers running on pasture had 578 pounds of corn and cob meal and 38 pounds of cottonseed meal, and pasture, at a cost of

only $11.91, for 100 pounds gain. When the animals were sold, 7 of those fed in the barn brought $10.35 a hundredweight, and 2 of them $9. Eight of those on pasture marketed for $10.35 a cwt., one for $9.

*Pasture Production.* The untreated field produced 47.5 pounds of beef per acre during the grazing season; the field treated with rock phosphate, 192.5 pounds, and the field treated with limestone and superphosphate, 211 pounds. This is the first year that either treated pasture has produced 200 pounds per acre.

The nature of the vegetation on the three fields has not changed significantly tho the tame grasses appear to be more prominent than formerly. Broom sedge and sour dock are becoming somewhat more abundant on the field treated with limestone and superphosphate. The untreated field is practically free of these weeds except in the bottom of the draw where the soil is better than in the rest of the field. There the broom sedge is dominant.

*Apples.* A very small crop of apples was produced. The cultivated plot seems to be making considerably more growth than the sweet clover or the lespedeza plots and has produced more fruit. The average circumference of the trunks of the trees under cultivation is 2.3 inches larger than of the trees in sweet clover and 2.5 inches larger than that of the trees in lespedeza.

*Peaches.* A crop of 816 bushels was produced in 1935. The contrast between all plots receiving cultivation and those in sweet clover or lespedeza sod is becoming more marked each year. The cultivated trees have made decidedly better growth and the crop was three to five times larger than that from the trees in sod. The cultivated plot with no application of fertilizer but with a cover crop of oats each year made better tree growth and a larger crop than the plots in legume sod with an annual application of four pounds of sulfate of ammonia per tree. The application of nitrogen to the cultivated plots increased the yield about 60 percent. The plots fertilized regularly, cultivated from April to August 1, and sown to a cover crop have made the best tree growth and crops. No striking difference can be noted in oat, rye, barley, soybean or cowpea

cover crops so far as their influence on the trees or crop is concerned.

Cultivation with regular additions of nitrogen fertilizer and barnyard manure, forced the trees into excessive growth and reduced the crop. Also, the color of the fruit was poor because of the density of the foliage.

*Peach Orchard Drainage.* Despite the wet season, there was no evidence that the tile drains had any influence on the trees. The untiled plot had slightly the best yield, but this is not considered significant. The orchard produced 708 bushels of peaches this year.

*Peach Orchard Management.* The best plots in this orchard have been given the following soil management: cultivation in the spring from April or May to about June 1, sown to cover crop of soybeans which are disked down September 1 and sown to rye for a winter cover. All trees in this orchard are nitrated alike. The plot that has been kept in sweet clover sod and the plot that has been in Korean lespedeza have produced the smallest trees and the crop on these plots this year was about half that of the cultivated plots.

Plot 1. No cutting back and very light thinning. The crop was the largest in the test. The trees have become very tall and fruiting wood for the future is limited chiefly to the tops. This type of pruning is clearly undesirable, even tho the crop may be larger for the first year or so.

Plot 2. Severe cutting back and thinning. The crop was reduced severely. The fruit produced was of good size and color. This type of pruning appears to reduce the size of the crop more than is necessary to produce a good grade of fruit. However, trees on very thin soil, that are not strong enough to size up a large crop, probably should be pruned severely.

Plot 3. Moderate thinning and cutting back, representing what is commonly known as standard pruning. The crop was intermediate in size between the crops from plots 1 and 2. The crop sized up well, the trees are moderately low and have good capacity for future crops, and the fruit buds appear to be strong and vigorous. This type of pruning appears to be superior to that of either Plot 1 or Plot 2.

Plot 4. Pruning similar to that on Plot 3, except that low

branches hanging near the ground were removed. The size of the crop was reduced somewhat. This kind of pruning is not advisable unless the branches interfere with the use of orchard tools.

*Oriental Peach Moth.* Damage from the oriental peach moth was very severe. It is estimated that about one-fourth of the crop was reduced to culls by this insect.

*Strawberry Fertilizers.* The season was favorable and the crop harvested was one of the largest since the experiment began. As with previous crops, there was little indication that the addition of any fertilizer, beyond the original use of 400 pounds of superphosphate and 1 ton of limestone per acre applied in 1926, and the growing of sweet clover in the rotation, was beneficial to the strawberry crop. The application of nitrogen fertilizer for this crop was made in August instead of March as for previous crops. There is some indication that the late summer application was more beneficial than spring fertilization.

*Red Raspberries.* The work with red raspberries was confined to spraying and fertilizer experiments.

Five sprays of 4-4-50 Bordeaux mixture were applied, on May 16, June 8, July 13, August 6 and August 28, 1934. Sprayed rows averaged 300 crates an acre, the unsprayed rows 210 crates, making the increase due to spraying 90 crates.

In the fertilizer test, manure at the rate of 20 tons an acre, was compared with sulfate of ammonia at the rate of 300 pounds an acre. Both were applied the first of April. The manure and sulfate of ammonia were almost equally effective, tho manure was slightly better. Fertilized rows averaged 295 crates an acre, unfertilized rows only 145 crates, making the increase due to fertilizer 150 crates. Raspberries that were both sprayed and fertilized, yielded 335 crates an acre, whereas those neither sprayed nor fertilized yielded 93 crates, indicating that the increase due to spray and fertilizer was 242 crates. These results are so significant that there can be no doubt as to the value of these practices in raspberry culture.

*Dewberries.* The dewberry crop was very poor. No marked beneficial effect could be noted from spraying with Bordeaux mixture or from the two systems of pruning tried.

*Meetings.* Certain annual meetings have become an estab-

lished feature at the Western Kentucky Substation. Those held during the year were the Fourth Annual Short Course, the 4-H Club leaders' conference, the Pennyroyal District 4-H Club Camp and the annual field day meeting. The field day meeting was attended by more than 700 persons.

## New Projects

Korean lespedeza hay versus lespedeza sericea hay for stocker calves.

Effects of age and crossbreeding on reproduction of the turkey.

Distillery by-products as feeds for hogs.

Hibernation studies of the corn earworm.

## Publications

**Bulletins:**

No. 356. (Research) The serological differentiation of hemolytic streptococci of human and animal origin. P. R. Edwards. March, 1935.

No. 357. (Research) Types of farming in Kentucky. Bruce Poundstone and Walter J. Roth. June, 1935.

No. 358. Part-time farming in four representative areas of Kentucky. Merton Oyler and W. W. Rose. August, 1935.

No. 359. Incubation experiments with turkey eggs. J. Holmes Martin and W. M. Insko, Jr. December, 1935.

No. 360. (Research) 1. Do tobacco plants recover from, and develop immunity to ringspot? 2. Susceptibility of tobacco plants visibly affected with mild mosaic, to other strains of the virus. 3. Localization and resistance to tobacco mosaic in Nicotiana. W. D. Valleau and E. M. Johnson. December, 1935.

No. 361. (Research) 1. Burning and non-burning strains of tobacco mosaic. 2. The ringspot symptom of virus diseases of plants. 3. Mosaic from tobacco one to fifty years old. W. D. Valleau and E .M. Johnson. December, 1935.

**Regulatory Series Bulletins:**

No. 6. Seed inspection in Kentucky, 1932–1934. W. A. Price, E. C. Vaughn, Encil Deen, Jessie Taylor and Alice Marrs. January, 1935.

No. 7. Commercial feeds in Kentucky in 1934. J. D. Turner, H. D. Spears, W. G. Terrell and L. V. Amburgey. July, 1935.

No. 8. Inspection and certification of nurseries in Kentucky, with a brief report for the year ended June 1, 1935. W. A. Price and Howard G. Tilson. July, 1935.

**Annual Reports:**

47th Annual Report of the Station, Part I, Report of the Director for 1934. Thomas Cooper.

**Scientific Papers:**

An example of spread of veinbanding from potatoes to tobacco. E. M. Johnson. Phytopath. 25: 650–652, 1935.

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## FINANCIAL STATEMENT

**In Account with the United States Appropriations, 1935**

| | Hatch Fund | Adams Fund | Purnell Fund |
|---|---|---|---|
| Receipts: | | | |
| From the Treasury of the United States, as per appropriations for fiscal year ended June 30, 1935 | $15,000.00 | $15,000.00 | $60,000.00 |
| Expenditures By: | | | |
| Personal services | 14,448.28 | 14,301.04 | 53,469.23 |
| Supplies and materials | | 169.71 | 1,979.76 |
| Communication service | | | 62.46 |
| Travel expenses | 188.82 | | 1,159.36 |
| Transportation of things | | | 18.81 |
| Printing and illustrating publications | 362.90 | | 668.81 |
| Heat, light, water and power | | 29.21 | 26.26 |
| Contingent expenses | | | 44.00 |
| Equipment | | 500.04 | 2,571.31 |
| Total | $15,000.00 | $15,000.00 | $60,000.00 |

We, the undersigned, duly appointed auditors of the expenditures, from Federal appropriations reported herein, do hereby certify that we have examined the books and accounts of the Kentucky Agricultural Experiment Station for the fiscal year ended June 30, 1935; that we have found the same well kept and classified as above; and that the balances, receipts and disbursements are as follows:

| | Hatch Fund Act of Congress March 2, 1887 | Adams Fund Act of Congress March 16, 1906 | Purnell Fund Act of Congress Feb. 24, 1925 | Totals All Funds |
|---|---|---|---|---|
| Receipts for the year from the Treasurer of the United States | $15,000.00 | $15,000.00 | $60,000.00 | $90,000.00 |
| Disbursements for the year | 15,000.00 | 15,000.00 | 60,000.00 | 90,000.00 |
| Unexpended balance June 30, 1935 | None | None | None | None |

Proper vouchers for all of the above disbursements are on file and have been examined by us and found correct.

And we further certify that the expenditures have been solely for the purposes set forth in the acts of Congress approved March 2, 1887, March 16, 1906, and February 24, 1925, and in accordance with the terms of said acts, respectively.

Signed:

THOMAS COOPER,
*Director of the Experiment Station*

D. H. PEAK, Business Agent,
*Financial Officer of the Institution*

D. H. PEAK,
*Secretary of the Governing Board*

Attest:

JANE J. NICHOLS,
*Custodian of the Seal.*